Report on International

OIL AND GAS JURNAL

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BJ NEW Type B Power Slip

TAKE A LOOK at this new BJ Type B Power Slip—see for yourself what *new* engineering, *new* design advancements, *new* field testing and proving can do for economical power slip operation on your rig.

COMPACT! Note the single cylinder for pressure raising and *pressure setting* of slips . . . the offset arm construction for increased work room . . . *unitized* slips which can be quickly changed for different pipe sizes by simply removing two bolts.

FAST! The Type B sets and releases at the touch of the driller's foot, gives pressure-centering of pipe. Slip ring rotates with a free floating action when making up and breaking out with the rotary table.

SAFE! In set position, slip ring body clears rotary table by several inches—an important safety feature. Capacity of the new Type B Power Slip is more than enough for today's deepest wells and heaviest strings.

The new Type B Power Slip handles 2¾" to 7" drill pipe by simply changing slips. Compact sub-base design permits unitizing the power slip with any rotary table and *installation is made without changing your rig substructures.* Write for new Bulletin giving full details—find out how you can handle your pipe strings easier, faster and safer with the new BJ Power Slip. *Or see your BJ representative—today.*

SIDE OPENING FEATURE of the BJ Type B Power Slip enables the crew to swing the Slip into operating position around the pipe in a matter of seconds by simply removing a single pin and opening the arm gate. When the gate is closed and the pin re-inserted the slip is ready to operate.

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Albert Beveridge, tool pusher for Robstock & Reeves and Gulf Coast Drilling Company of New Orleans, says:

"REED Bits give fast, straight hole in South Louisiana."

REED LT Rock Bit for soft formations

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Liquid-blast
ROCK BITS

"Here in the soft formations of the South Louisiana coastal fields, we like REED LT Rock Bits for fast drilling and straight hole. They help us keep down drilling costs."

REED Liquid-Blast Rock Bits do a good job in soft formations because jets of drilling fluid clean both the cutters and the bottom of the hole.

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In every fast moving industry, problems arise which cannot be solved by existent equipment. That's when the world wide experience of Shand & Jurs becomes invaluable to producers, refiners and marketers the world over. Always anxious to cooperate in the field of standard equipment, we are equally eager to explore new problems with substantial members of the petroleum industry.

When you buy petroleum tank fittings, it is distinctly advantageous to stop and shop at the industry's super market. Here you can buy everything you need in quality fittings on one order, one shipment, one delivery. Everything fits perfectly when it arrives on the job. There is no divided responsibility. Buy it all from S. & J. and avoid disappointments.

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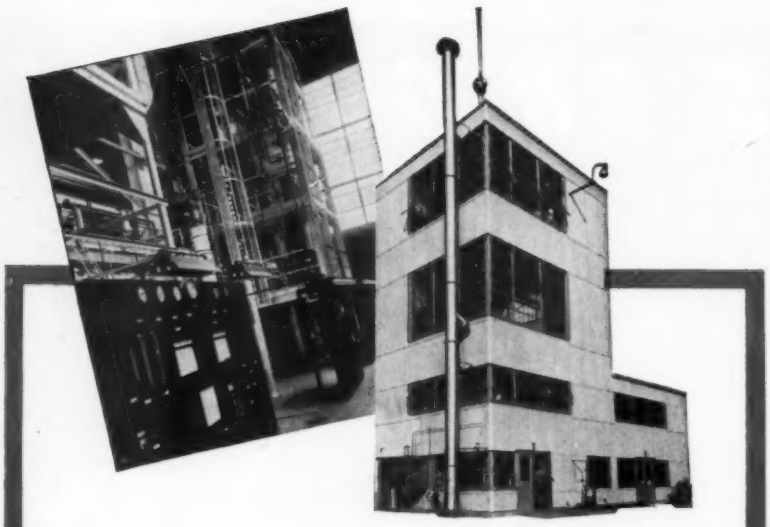

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Interesting facts and figures on the synthesis of *Aldehydes, Alcohols, Organic Acids, Esters, Waxes, Olefins,* and *Synthetic Fuels* are available.

We shall be pleased to offer preliminary recommendations without obligation.

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They Say—

'Phillips Thinks Twice'

"Signal distinction has come to Phillips Petroleum Co., first by its selection to operate the Idaho plant of the Atomic Energy Commission, and second by the appointment of Dr. George G. Oberfell to advise the Reconstruction Finance Corporation about strategic materials production. Dr. Oberfell is one of the practical genii of the Phillips laboratories, now retired.

"In the Idaho plant Phillips scientists will build the reactors that are expected to harness atomic power for the peacetime uses of running factories, propelling ships and, perhaps, keeping giant airplanes aloft indefinitely. This isn't such a side step as it might be viewed at first glance. The oil industry now supplies the fuel for these purposes. Phillips obviously intends to continue in business whether the basic fuel is to be petroleum or other pure or synthetic minerals. It is going to be Phillips Propulsion Co., though it may not get around to changing its name for years. . . .

"Phillips has a spread of talents over a great field—oil and gas production and processing, chemical plants, and synthetic rubber. This is good for the United States, and for Phillips. We are proud of our Bartlesville neighbor."

Editorial in the Tulsa Tribune.

Gasoline Is Cheaper

"It is notable that the various progressive steps adopted by the oil industry to transport its crude oil and the products of refining at lower costs and with greater efficiency—the pipe lines, barges, and trucks—together with the technological advances in refining processes, have resulted in a lowering of the prices charged by the oil companies. If we exclude taxes, the average price of a gallon of gasoline in 50 cities of the country in 1918 was 25.1 cents; today it is 20 cents, or over 20 per cent lower."

Lee R. Cowles, traffic manager, Standard Oil Co. (Indiana) speaking to the Chicago regional chapter, of Association of Interstate Commerce Commission Practitioners.

Likes Drilling Articles

Sir:

We wish to thank you for sending us the two copies of the article on drilling which you reprinted from the October 5 issue of The Oil and Gas Journal.

We consider that your article has been a great service to those persons connected with the oil industry but

Christmas in Land of Palm and Pine

From the Arctic Tundras of Alaska to the steaming Jungles of Sumatra, anywhere oil might be found, intrepid pioneers have carried on their search for the Golden Fluid.

With a special remembrance to those working on Wilson Rigs away from home during the holiday season.

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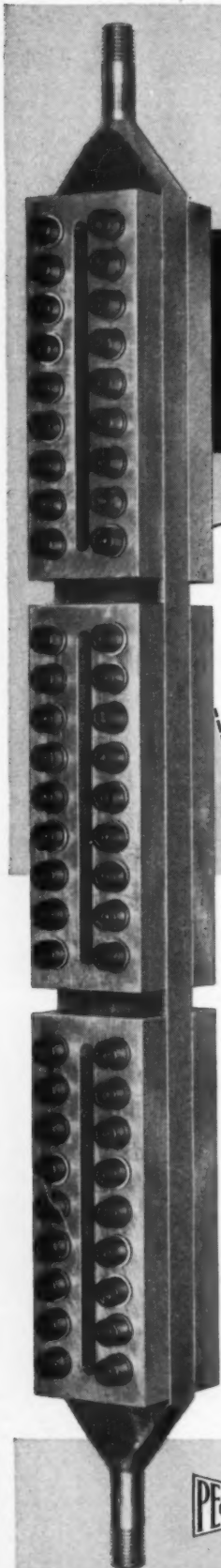

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In addition to their value as liquid level indicators, these gages are useful as reaction chambers, equilibrium cells, high pressure manometers, etc.

The standard gage body containing the liquid chamber is forged carbon steel but stainless steels are available. Design is such that glass is entirely relieved of bolting pressure . . . providing a better seal and avoiding those stress concentrations which cause so much glass breakage.

These Penberthy 10,000 psi gages are of proven dependability . . . they have been in field service for more than two years. Write us regarding your requirements.

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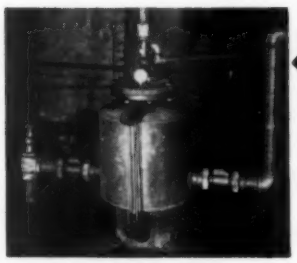
PENBERTHY REFLEX GAGE. Empty space shows white, liquid shows black. You can't misread. Available in special alloys and now available for operating pressures up to 5,000 psi. Ask for Catalog 35.



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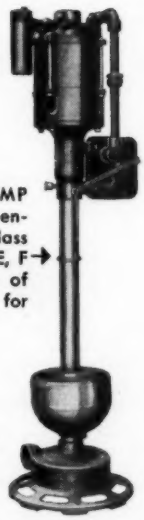
PENBERTHY EXPLOSION-PROOF SUMP PUMPS. Motor and switch totally enclosed. Underwriter approved for Class 1, Group D, and Class 2, Groups E, F and G hazardous location. Made of copper and bronze throughout. Ask for Bulletin 4929.

PENBERTHY EJECTORS. A simple jet pump operated by air, water or steam. Needs no lubrication . . . will not get out of order. Ask for Bulletin 5080.



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who do not possess intimate knowledge of production methods.

We look forward to any future articles of general interest that you may print on one or more of the interesting and varied aspects of the oil industry.

Eugene E. Woodward,
Kerr-McGee Oil Industries, Inc.,
Oklahoma City, Okla.

The Shocks Ahead

"The petroleum industry, providing the source of 1 dollar in every 20 raised by our Government in taxation, has won the right to the confidence of the American people, and the right to go on, with the minimum regulation and restriction, to do the immense job ahead.

"It is always a pleasure to congratulate ourselves upon a job well done, but it is a duty to prepare ourselves for a series of shocks ahead.

"Among these shocks will be a large number of controls which will affect directly every man in this room. Their impact will soon be felt in every phase of the oil business—in production, in refining and manufacturing, in transportation, in marketing.

"We already know what some of these controls will be. Others are in preparation or under discussion. Here are just a few which are of direct and immediate concern to all of us: Allocation of crude oil supplies, allocation of materials required for expansion and rehabilitation, such as steel and other building supplies, product quality controls, transportation controls, manpower controls, and, of course, controls over earnings and prices.

"The list will grow longer every day that we live in a war economy. One control leads to another. Restrictions and regulations proliferate like the branches of a tree."

H. E. Brandli, vice president and general manager, Cities Service Oil Co., addressing Independent Oil Men's Association, Boston.

CALENDAR

1951

January

American Gas Association, home-service workshop, Hotel Statler, Washington, D. C. January 3-5.

Kansas Oil Men's Association, annual convention, Lassen Hotel, Wichita, January 8-9.

Society of Automotive Engineers, annual meeting and engineering display, Hotel Book-Cadillac, Detroit, January 8-12.

Pipeline Contractors Association, annual convention, Shamrock Hotel, Houston, January 9-10.

American Institute of Electrical Engineers, Tulsa Section, meeting on explosion-proof motors, Michaelis Cafeteria, January 11.

Kansas-Oklahoma Water Flood Operators, monthly meeting, Booth Hotel, Independence, Kans., January 17.

Southwestern Legal Foundation, second annual institute on oil and gas law and taxation, Southwestern Legal Center, Dallas, January 18-20.

FOSTER FLOW TUBE*
(Gentile Patents)

Less Throat Constriction

Less Flow Restriction

Study the above picture of the Foster Type V Flow Tube which operates on the viscous drag principle. Note the almost straight-through construction. There's only a slight throat constriction. And the same minimum throat constriction is typical of the Type D Flow Tube which operates on the principle of dynamic impact. *Both types offer minimum resistance to flow.*

You know what this means. Negligible unrecovered head loss in the flow of the liquid or gas. Less power required to push it along.

"Good," you say, "but what about accuracy?"

The Foster Flow Tube will measure the flow of liquids or gases with an accuracy at least comparable to that of conventional primary devices and, in most cases, with considerably greater accuracy, because it can readily be installed in that section of the hydraulic system where flow conditions are uniform and steady. Thus, with this unique Flow Tube, you can combine accuracy with neglible head losses—accuracy with compactness—accuracy with ease of installation.

Write us in detail about your problem, giving both processing and installation requirements. We have several types and units in all commercial pipe sizes.

*A Proved Flow Tube Added to Foster Line of Regulating Valves

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Names on request

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L.P.G. Engine Fuel School, Kansas State College, Manhattan, Kans., January 21-23.

Compressed Gas Association, annual meeting, Waldorf-Astoria Hotel, New York City, January 22-23.

Northwest Petrcleum Association, annual convention, Nicollet Hotel, Minneapolis, January 25-26.

Southern Gas Association, employe-relations section and accident-prevention round tables, Mobile, Ala., January 26.

Instrument Society of America, New York section, Hotel New Yorker, New York City, January 26-27.

February

American Institute of Electrical Engineers, Tulsa Section, meeting on explosion-proof electrical equipment, Michaelis Cafeteria, February 8.

American Institute of Mining and Metallurgical Engineers, annual meeting, Jefferson and Statler hotels, St. Louis, February 19-22.

Kentucky Petroleum Marketers Association, annual meeting and trade show, Brown Hotel, Louisville, February 20-21.

Kansas-Oklahoma Water Flood Operators, monthly meeting, Booth Hotel, Independence, Kans., February 21.

National Association of Corrosion Engineers, Tulsa Section, Short Course on Practical Control of Pipe-Line Corrosion, Mayo Hotel, February 21-23.

Iowa Independent Oil Jobbers' Association, Inc., annual convention, Hotel Fort Des Moines, Des Moines, February 21-22.

Wisconsin Petroleum Association, annual convention and equipment show, Milwaukee Auditorium, Milwaukee, February 27-28.

March

American Association of Petroleum Geologists, Rocky Mountain Section, Shirley Savoy Hotel, Denver, March 1-2.

American Society for Testing Materials, spring meeting and committee week, Cincinnati, March 5-9.

American Petroleum Institute, division of production, southwestern district meeting, Hotel Beaumont, Beaumont, Tex., March 7-9.

Indiana Independent Petroleum Association, spring convention and refiners and suppliers exhibit, Hotel Severin, Indianapolis, March 8-9.

Mid-West Gas Association, Hotel Fontenelle, Omaha, March 12-14.

Illinois Petroleum Marketers Association, annual convention, Sherman Hotel, Chicago, March 13-15.

National Association of Corrosion Engineers, annual conference and exhibition, Statler Hotel, New York City, March 13-16.

Gas Appliance Manufacturers Association, annual meeting, The Homestead, Hot Springs, Va., March 19-21.

Ohio Petroleum Marketers Association, annual convention and marketing exposition, Deshler-Wallick Hotel, Columbus, Ohio, March 20-22.

American Petroleum Institute, division of production, Mid-Continent district spring meeting, Herring Hotel, Amarillo, March 21-23.

Texas Independent Producers and Royalty Owners Association, fifth annual meeting, Beaumont, Tex., March 27-28.

New England Gas Association, annual meeting, Hotel Statler, Boston, March 29-30.

April

American Gas Association, industrial and commercial gas section, conference on industrial and commercial gas, Shoreham Hotel, Washington, D. C., April 2-4.

American Society of Mechanical Engineers, spring meeting, Atlanta, April 2-5.

Instrument Society of America, New Jersey section, Essex House, Newark, N. J., April 3.

American Petroleum Institute, division of production, Eastern district meeting, Deshler-Wallick Hotel, Columbus, Ohio, April 3-5.

Mid-West Regional Gas Sales Conference, Edgewater Beach Hotel, Chicago, April 9-11.

Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, April 10-12.

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American Gas Association, distribution, motor vehicle, and corrosion conference, Hotel Peabody, Memphis, April 16-18.

American Society of Lubrication Engineers, annual convention and lubrication show, Bellevue-Stratford Hotel, Philadelphia, April 16-18.

National Petroleum Association, Hotel Cleveland, Cleveland, April 18-20.

American Petroleum Institute, Rocky Mountain district spring meeting, Gladstone Hotel, Casper, Wyo., April 19-20.

Southern Gas Association, Buena Vista and Edgewater Gulf hotels, Biloxi, Miss., April 23-25.

American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, Society of Exploration Geophysicists, joint annual meeting, Jefferson Hotel, St. Louis, April 23-26.

Natural Gasoline Association of America, annual convention, Mayo Hotel, Tulsa, April 25-27.

Indiana Gas Association, French Lick Springs Hotel, French Lick, Ind., April 26-27.

American Gas Association, industrial and commercial gas section, industrial gas school, William Penn Hotel, Pittsburgh, April 29-May 4.

American Geophysical Union, thirty-second annual meeting, National Academy of Sciences, Washington, D. C., April 30-May 2.

American Petroleum Institute, division of refining, sixteenth mid-year meeting, Mayo Hotel, Tulsa, April 30-May 3.

May

American Gas Association, Natural-Gas Department, Dallas, May 7-8.

Independent Petroleum Association of America, mid-year directors' meeting, Cosmopolitan Hotel, Denver, May 7-8.

Gas Appliance Manufacturers Association, natural-gas department spring meeting, Dallas, May 7-9.

Liquefied Petroleum Gas Association, annual convention and trade show, Stevens Hotel, Chicago, May 7-10.

American Petroleum Institute, division of production, Pacific Coast district, spring meeting, Biltmore Hotel, Los Angeles, May 10-11.

American Institute of Chemical Engineers, regional meeting, Hotel Muehlebach, Kansas City, May 13-16.

American Gas Association, operating section, production and chemical conference, Hotel New Yorker, New York City, May 14-16.

Pennsylvania Gas Association, Wernersville, Pa., May 15-17.

American Petroleum Institute, division of marketing, mid-year meeting, Cincinnati, May 28-29.

Third World Petroleum Congress, Kurhaus, Scheveningen, the Netherlands, May 28-June 6.

American Petroleum Institute, standardization and standing committees, division of production, mid-year meeting, Brown Palace Hotel, Denver, May 28-June 1.

June

American Society of Mechanical Engineers, semiannual meeting, Toronto, Ont., Canada, June 11-15.

Canadian Gas Association, Bigwin Inn, Lake of Bays, Ont., Canada, June 16-20.

American Society for Testing Materials, annual meeting, Atlantic City, N. J., June 18-22.

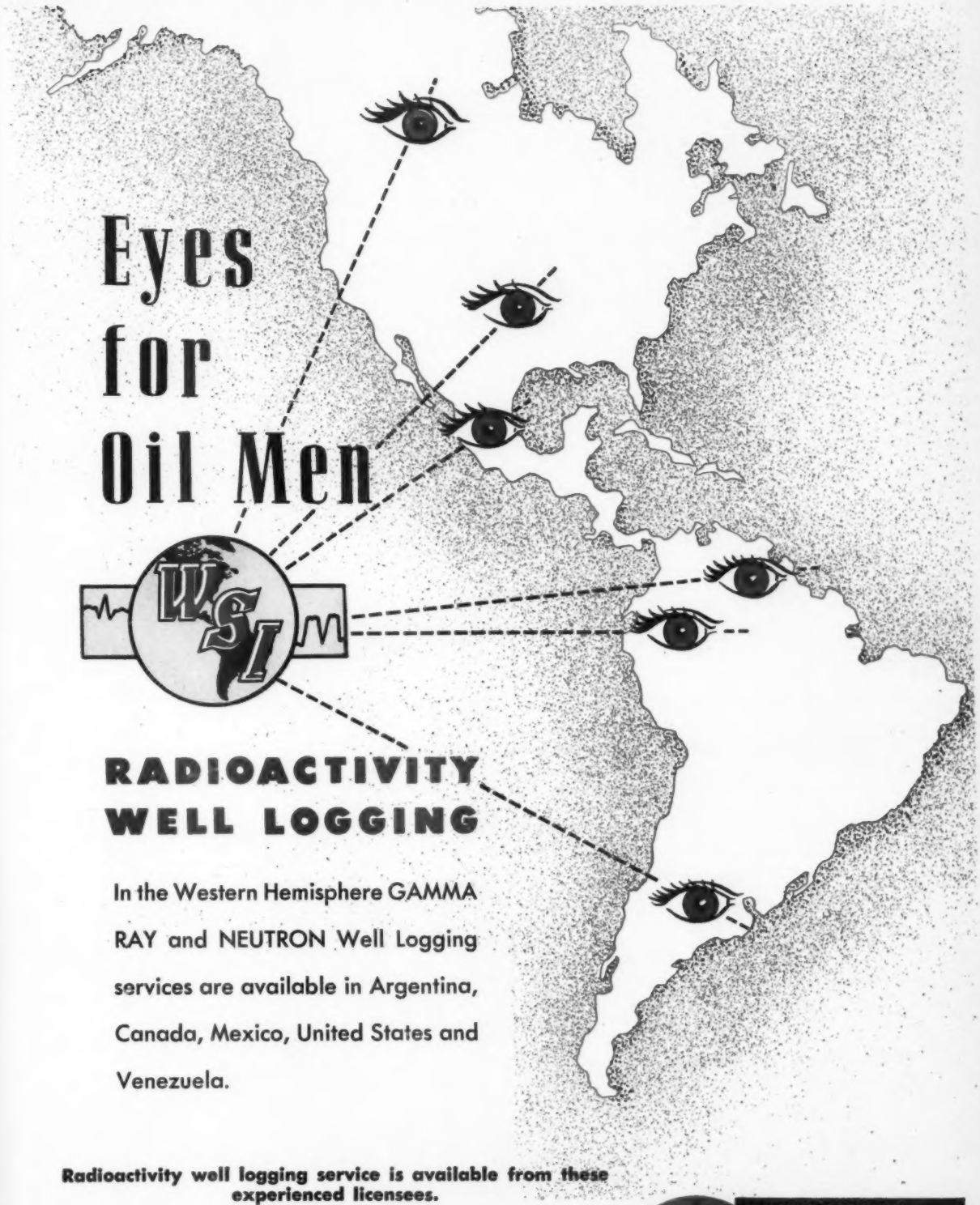
NOMADS

Tulsa Nomads, third Friday of each month. After Five Room, Tulsa Hotel.

Dallas-Fort Worth Nomads, first Monday of each month, Greater Dallas Club.

Houston Nomads, second Monday of each month. Ye Olde College Inn, Houston.

Los Angeles Nomads, second Wednesday of each month, Jonathan Club.



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JOURNALLY Speaking

Stalin's Achilles Heel

DO the Russians have enough oil to fight a war? Look on page 214 for the answer.

A lot of people have been asking us this question lately, some suggesting that our favorite oil publication ought to conduct extensive research and come up with an authoritative yarn on oil behind the Iron Curtain.

Good as we are, however, we didn't hanker for an extensive project of what the commies call "counterrevolutionary espionage," so we shied away from the assignment. But we did something else that was a lot better and safer. We induced the best source in the country to do this job especially for us.

Up at Harvard University a bunch of refugees, emigres, and others spend all their time combing Russian publications and everything else they can get hold of that gives clues to life behind the Iron Curtain. From these extensive files one of their top men, Demitri Shimkin, prepared the article in this issue. We believe it is authoritative, objective, and as complete as humanly possible. Certainly it beats anything we have seen anywhere else.

Our friend Demitri doesn't come right out and say the Soviets would lose a war for lack of oil. You and Stalin's generals will have to decide that for yourselves. But his article makes it pretty clear that the Russians don't have much oil to spare for military ventures and have very slim prospects for increasing their supply.

Oil may very well be Stalin's Achilles heel—in a war like World War II. But don't get too confident over this. Could be that the Kremlin is aware of this and is doping out some different kind of war it could win without much oil.

Phony Figures

EVERY year in our International number we run detailed tables giving the producing and refining capacity of every oil area of the world. This year we deliberately left some gaps. The gaps are all behind the Iron Curtain in Russia and her slave territories, or satellites, to use the more polite term.

We figured this way: What's the sense of purporting to give information we don't have and everybody knows we can't get?

For example, in other years we gave 1940 data on refineries which might have been bombed out during the war and on others which, it is a dollars-to-doughnuts bet, have been greatly altered during the ensuing blacked-out decade. We noted that some other publications have been doing the same thing, but we decided it was no service to the readers and might cast doubt on the currency and completeness of the rest of our figures, so we up and dropped the whole works.

We do carry some over-all estimates of crude production in commie areas. These weren't pulled out of a hat, but were based on the best sources we could find. But we skipped detailed figures where we didn't have pretty straight dope.

You may rest assured that the details we do present in this issue on oil fields and refineries of the world are up to date, complete, and straight from authoritative sources.

Oil on Our Side

RUSSIA keeps butting into our thoughts these days, and here's another angle that occurred to use in working on the material for this International number: The communist part of the world doesn't have much oil but our part has plenty.

How come? Is Nature just mean to the commies? Or does a shortage of oil promote communism? Or does communism promote a shortage of oil?

You're entitled to your own conclusion, but ours is No. 3. We claim that communism—or any form of government operation, for that matter—is incapable of finding much oil or building up much of an oil industry.

Be that as it may, this issue of the Journal certainly indicates that oil is on our side.

—Henry D. Ralph

Buying?

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Season's Greetings
- and the best in Health and Happiness
in the coming year!
H.C. Smith OIL TOOL CO.

Oil and Peace

At this season when men would like to think of peace and joy in the world, the oil industry is perforce preparing for possible war and misery.

The tragedy of this is emphasized by a look at what 5 years of peace have done for the oil industry of the world. This look can be had readily in this issue of the Journal, our annual review of international petroleum activity, progress, and outlook.

When the shooting stopped, a large part of the world's producing and refining facilities was in ruins. Areas which had oil in the ground could not produce or ship; areas which needed oil lacked the wherewithal to purchase or use it. Suitable equipment and personnel were at a premium. Markets were uncertain.

Today the world's oil industry is stable and in balance. There is enough oil for all consumers and enough market for all producers. Rehabilitation is nearing completion in most of the producing and refining areas, and expansion and modernization are proceeding rapidly throughout the world of oil. The future outlook, given peace, is for a steady and orderly increase in both supply and use around the globe.

This has been achieved by tremendous expenditure of initiative and capital, expenditures which would not have been made except in anticipation of prolonged peace and economic progress. That is the way of the free world, and in the case of oil it has brought benefits to producing and consuming countries alike during the past 5 years. Let alone, the oil industry can continue to find, refine, and transport oil throughout the world to bring better living to all peoples of the earth.

Bringing the world's oil industry into balance, of course, was both aided by and an aid to the world's general economic improvement. Postwar economic and financial rehabilitation gradually made it possible to build new refineries and other facilities and also provided the growing consumptive demands which make possible world oil trade. But this economic improvement could not have been achieved without oil to power the wheels of industry and agriculture.

In Europe and elsewhere the postwar recovery of the world's oil industry and the international flow of petroleum have speeded industrial output, revived transportation systems, increased agricultural production, and raised living standards. In those oil-producing areas where peace has prevailed the resumption of activity has stimulated the local economies and opened new vistas of better living.

Oil in peace promotes progress and helps bring joy to the world.

Merry Christmas ★ Happy New Year

THIS WEEK

INTERNATIONAL—World's oil industry generally in balance. . . . Activity and consumption increasing steadily. . . . Margin now about 10 per cent over demand. . . . ¶Crude production outside U. S. increased 16.7 per cent during 1950. . . . Outside Communist area refining capacity has increased to 10,590,285 bbl. daily. . . . ¶General trend is upward, with increases in exploration, production, and construction of facilities. . . . ¶International operations reviewed in special section of this issue. . . .

STEEL—NSRB clears way for increase of nearly 7,000,000 tons of steel capacity by granting necessity certificates providing for accelerated amortization of new facilities to be built by 19 steel companies at cost of more than $600,000,000. . . . ¶Programs to insure availability of badly needed steel and other materials for oil industry developed by PAD and are now awaiting NPA approval. . . . ¶Quick expansion of tank-barge fleet may be retarded by difficulties in obtaining steel plate. . . .

CONTROLS—President's declaration of national emergency opens way for increased controls over all industry. . . . Office of Defense Mobilization set up to direct preparedness program. . . . ¶Controls beginning to take on characteristics of World War II setup. . . . Allocation of all vital materials necessary for defense a certainty. . . .

WASHINGTON—Senate committee reports New England's fuel situation is better than last year, with more abundant stocks on hand. . . . ¶Extensive study on supply and demand of benzene to be made by investigating committee. . . . ¶Concentration of refineries is greater than in most all other industry, government report shows. . . .

INDUSTRY—Transportation, refining need attention to assure free flow of hydrocarbons to meet military, civilian needs, PAD deputy director tells Compact Commission. . . . ¶Export of natural gas from Southwest may result in shortages in local areas, FPC member warns I.O.C.C. . . . ¶Crude-oil output won't have to increase to meet present demands, I.P.A.A. vice president declares before compact. . . . ¶U. S. tanker fleet is faster, larger than in 1939, American Merchant Marine committee reports. . . . ¶Texas Railroad Commission orders continuation of present oil output for January. . . . Present gas-oil ratio rule to be maintained. . . .

PIPE LINES—Los Angeles firm seeking approval to construct 24-in. crude-oil line and parallel products line from Texas to California. . . . Capacity would be 250,000-300,000 bbl. daily. . . . ¶Plans under way for 2,100-mile natural-gas line with capacity of 350,000 M.c.f. daily from Texas Gulf Coast area to Pacific Northwest. . . .

ACTIVITY—Crude production for week ended December 16 averaged 5,642,350 bbl. daily, down 23,675 bbl. daily from previous week. . . . ¶Well completions totaled 863 for the week compared with 842 for previous week and 871 for same week last year. . . . Wildcat completions decreased 21 wells to 172 for the week. . . . ¶Rotary rigs operating in United States on December 11 set a new record at 2,407 rigs, up 32 from week earlier date. . . .

TRENDS—Current crude production and import rates will support refinery runs of about 6,050,000 bbl. daily without reductions in crude inventories. . . . Crude and field condensate production is averaging about 5,725,000 bbl. daily. . . . ¶Calculated crude imports add 500,000 bbl. daily for a total new crude supply of 6,225,000 bbl. daily. . . . ¶Exports, transfers, and losses are estimated at 175,000 bbl. daily. . . .

NATURAL GAS—Tennessee Gas Transmission asks approval of $47,403,000 expansion program which would increase its system capacity by 115,000,000 cu. ft. of gas daily. . . . ¶Utah Pipe Line Co. asks FPC to approve 392-mile natural-gas-transmission line from Aztec, N. M., to Salt Lake City. . . .

EAST MEETS WEST.—The most significant international oil event of 1950 was this scene December 2 when the first four tankers loaded Persian Gulf crude oil at the Lebanon terminal of the 1,068-mile Trans-Arabian Pipe Line. The $230,000,000 Tapline, largest single undertaking ever carried out by private American capital in oil or any other industry, will bring 300,000 bbl. per day of Middle East oil to the Mediterranean, most of it for refineries of western Europe. This is typical of the postwar rehabilitation and shifts in the world's oil industry described in detail in this issue starting on page 153.

Materials for Oil

Programs to insure availability of urgently needed supplies for drilling, refining awaiting NPA approval

Bertram F. Linz

WASHINGTON. — Programs to insure the availability of urgently needed materials for the oil industry have been developed by Frank Watts, director of materials for the Petroleum Administration for Defense, and are now awaiting approval by the National Production Authority.

The purpose of the programs will be to insure against the interruption of wildcat, field, and offset well drilling and prevent the shutting down of refineries for lack of replacement materials and equipment for breakdowns.

Under the plan submitted to the NPA, mills and warehouses would be required to reserve 5 per cent of average monthly production of oil-country tubular goods for the specified types of wells when supplies could not be procured through normal channels. The mills now are producing approximately 150,000 tons of tubular goods monthly, which would give about 7,500 tons for the reserve.

Operators unable to secure tubular goods from their normal sources would have to submit a statement to the mills or warehouses, giving full information regarding the well, whether wildcat, field, or offset, and agreeing that if the material secured from the reserve was not used in 30 days it would be made available for shipment to another hard-up operator.

Drilling.—In the case of drilling operations, copies of the certificates would be sent to PAD, but in the case of refiners or equipment manufacturers taking advantage of similar provisions for forms and shapes other than tubular goods, or mechanical or pressure tubing, the application would have to be filed with PAD for approval.

Watts disclosed that PAD has come to an agreement with the Defense Department under which it will be able to issue priorities for materials required for completion or operation of refining or other facilities to produce products for military or defense use. The DO (Defense Order) ratings also will be issuable for materials required for the construction of new facilities for defense purposes.

Steel needs.—At a press conference called by Deputy Administrator Bruce K. Brown, Watts indicated that the steel needs of the oil and gas industries would be handled in segments. He explained that, while the National Petroleum Council estimates of 11,650,000 tons of steel needed for 1951 is considered "realistic," it contains many items which are not normally charged to the industry, such as steel for tankers, tank cars, and containers, as well as steel for gas pipe lines not yet approved by the Federal Power Commission. With respect to the last, Watts expressed doubt whether the mills could supply the line pipe in full in addition to the material which will be required for other purposes.

This week, PAD officials met with representatives of NPA and the steel and oil industries to discuss a method of setting up the figures on a mutually agreeable basis, and Watts said he is hopeful of getting the steel necessary for the 43,000 wells which it is estimated must be drilled in 1951.

Transport director.—Reviewing PAD's current activities, Brown announced that Dene Hodges, vice president of Shell Oil Co. for transportation and supply, has been appointed director of the transportation division and will immediately start to build up a staff to work with the Defense Transportation Agency and the military and other agencies to solve transportation problems. Hodges is already familiar with the transportation situation, having been a member of the military petroleum advisory board and chairman of its transportation panel.

Hodges last week held a conference with representatives of the tanker operators, the military sea transportation service, and Commerce and Justice departments to discuss means by which the tanker people may assist the Navy by providing additional vessels. However, he said, it is not intended that the Navy's needs be met at this time by diverting tankers already in useful service.

Gas division.—The setting up of PAD's gas division and appointment of its head will be discussed by Brown January 9 with representatives of the gas industry which also will canvass the problems, current and anticipated, affecting gas operations.

Brown said that so far there has been no discussion in government circles of oil prices, but that he has met Dr. Valentine, head of the Equalization Stabilization Agency.

Brown also repeated previous statements that he sees nothing in the current situation to indicate any need for gasoline rationing.

"I see no reason to assume that gasoline for automobiles will be in such short supply as to require rationing as the result of shortages created by an armament program or a mobilization program," he said in a formal statement. "The military currently uses less than 5 per cent of the petroleum consumed in this country and there can be much more mobilization without straining present supplies.

Tubular goods.—"Any impairment in the supply of oil-country tubular goods resulting in a lessened drilling of oil wells would, in time, shorten the supply of oil. However, under presently existing mobilization conditions I am hopeful that the well drilling program can be fully supported with material."

Brown was less sanguine with regard to quarters for the PAD, pointing out that only 9,000 sq. ft. of space has been found for it so far and at least 11,000 sq. ft. more must be provided for the anticipated staff, with little indication at the moment that this can be done in the Interior Department building.

A number of applications for necessity certificates permitting quick amortization of investment in new facilities have been sent to PAD by the National Security Resources Board for consideration, Brown disclosed, estimating that the total construction represented by the applications is in excess of $30,000,000.

The applications cover projects for refinery facilities for military products, general refinery capacity, storage, catalyst production, and pipe lines. None of them has been processed yet because of lack of personnel, Brown said, explaining that they will be considered solely on physical factors.

Tank-Barge Fleet

Short steel supply may curtail quick expansion

WASHINGTON.—The tank-barge fleet today is considerably larger than that with which we went into World War II, but difficulties in securing steel plate threaten to retard quick expansion to meet new needs.

Because of this, according to shipbuilding interests, orders for tank barges are piling up and deliveries this year have been cut considerably below those of 1949.

The Defense Transportation Agency is now working on a large construction program with the National Production Authority under which the latter will allocate the necessary material, but this program will not get under way until sometime next year.

At the beginning of the last war a

fleet of 1,400 petroleum barges was in service, and during the war about 125 new ones were built and 116 converted from dry-cargo service. In addition, 269 wooden barges out of an original program of 500 were constructed but the oil companies balked at using them because of the fire hazard and probable sea-water contamination.

Area totals.—The latest available statistics, compiled by the Army Engineer Corps, show that on January 1, last, there were 675 barges aggregating 754,642 gross tons in service on the Atlantic, Gulf and Pacific Coasts; 1,342 of 1,658,504 tons on the Mississippi and intracoastal waterways; and 69 of 130,422 tons on the Great Lakes.

In the first 10 months of this year 29 petroleum barges were delivered by shipyards which are members of the American Bureau of Shipping, but the exact size of the fleet now cannot be figured because of lack of information regarding barges retired from service, although it is believed it is practically the same as at the beginning of the year.

Deliveries in the 1950 period were 30 less than in the corresponding months of 1949, and barges on order increased from 23 at the beginning of the year to 38 on November 1. Only 3 towboats were delivered during the 10 months against 5 last year, while the number on order increased from 5 to 15.

Questions asked.—A questionnaire has been sent out to 150 shipbuilding and repair companies asking for information on the first-quarter steel requirements as the basis of the proposed barge-construction program. Commerce Department experts said the situation already is difficult and will become increasingly so as more and more barges are called for.

Meanwhile, the Army last week called for bids on the construction of more than 200 lighters and barges, including 64 liquid barges of which 5 will be built for West Coast delivery and 59 for East Coast delivery. These carriers presumably will be constructed under DO (Defense Order) priority ratings which will insure the provision of the necessary steel.

National Emergency

President's proclamation clears way for more controls on all industry; Office of Defense Mobilization formed

WASHINGTON. — The defense organization over the week end took on more of the characteristics of the World War II control set up.

President Truman issued a proclamation of national emergency and created a new Office of Defense Mobilization, which will be equivalent to the old Office of War Mobilization, with Charles E. Wilson, president of General Electric Co. who served as vice chairman of the War Production Board, as its director.

Price action.—The Economic Stabilization Agency rolled automobile prices back to their December 1 level, announced it was taking similar action promptly on other commodities, and disclosed that Orville Judd, who was assistant director of the fuel-price division of the Office of Price Control, has been brought in as consultant on oil prices.

Proclamation of a national emergency brought into operation a number of authorities held by the President on an emergency basis, but it was disclosed that additional legislation will be sought immediately giving the Government practically all of the control over the nation's economy that it held during the war.

PAD status.—While the Office of Defense Mobilization will have full control of the production, manpower, and other phases of the defense program, there is no indication that the status of the Petroleum Administration for Defense will be affected, even though Wilson is seen as having the authority to merge it into any organization that may be created to centralize production controls. The defense organization now so closely resembles its wartime predecessor that it is generally believed the oil-control agency will retain the same independence its wartime prototype enjoyed.

The ODM will take over the job of coordinating the activities of the defense agencies formerly held by Chairman Stuart Symington of the National Security Resources Board and is expected to take over from the board also the issuance of necessity certificates permitting quick amortization of defense-facility investments and certificates of applications for government loans for defense-plant construction.

The board will revert to its original status as a planning agency, and Symington, who thus loses his place in the active direction of the defense program, reportedly will be named secretary of defense when Gen. George Marshall relinquishes that post.

Shipping.—The President's proclamation brings into force a number of emergency powers, including full control by the Government over the operation of American-flag shipping and the transfer of vessels to foreign registry and authority to requisition vessels; authority to suspend the 8-hour law on contracts with the United States, and authority to waive competitive bidding on government contracts.

Wages.—The wage stabilization board this week laid down an 18-point program to prevent inflation, including various steps to increase production, higher taxes, reduction of government nonmilitary spending, credit controls, rent control, inventory limitations, controls over consumer, industrial, and farm prices and over speculative commodity markets, and stabilization of wages, salaries, and other compensation.

The board held that price and wage stabilization must be general, warning that to control specific areas of the economy will not in itself attack inflation at its sources but will only conceal and defer its effects while permitting a pressure of hidden spending power to build up.

Benzene Task Force

Study of supply, demand for next 10 years planned

WASHINGTON.—The National Production Authority last week set up a task force to study the supply and demand prospects for benzene for the next 5 to 10 years to determine the need for new production capacity, with indications that expansion of supply will be sought from the oil and coke industries rather than by construction of coal-hydrogenation plants.

The study was decided upon at a meeting of NPA officials with benzene producers and consumers at which preliminary estimates were submitted placing 1951 supply, including imports, at 207,000,000 gal. and demand at 220,000,000 gal.

The inquiry will be aimed primarily at expanding the supply of benzene from petroleum, although a spokesman for the Petroleum Administration for Defense said it will be late in 1952 before substantial quanties can be developed from that source. Increased supplies also will be sought by improvement of by-product coke plants now producing benzene and possibly by development of agreements under which substantial amounts of benzene, which it was said European brokers are holding for high prices, can be secured from foreign countries.

Supply increase. — The meeting discussed various possibilities of increasing the supply, including refinement of some motor-grade benzene into chemical grades, the substitution of petroleum products for benzene, and the eventual increase that will result

WATCHING WASHINGTON

Bertram F. Linz

Steel Increase

The National Securities Resources board already has paved the way for an increase of nearly 7,000,000 tons to our steel capacity by granting necessity certificates providing for accelerated amortization of new facilities to be built by 19 steel companies at a cost of more than $600,000,000.

The board apparently has concentrated largely on getting steel expansion under way, only three companies not in that industry having so far been given certificates. No certificates have been issued to cover new facilities for oil or gas.

Four of the 19 companies have extensive projects in view, it is indicated by certificates given Armco Steel Corp. for $153,992,406, Jones & Laughlin Co. for $144,000,000, Youngstown Sheet & Tube Co. for $86,095,000, and Lone Star Steel Co. for $73,425,200.

A large number of applications for certificates are pending in the NSRB, which plans to deal with them as expeditiously as possible. It has not been disclosed to what extent the oil and gas industries are taking immediate advantage of provisions of the tax bill enacted during the regular session of Congress permitting the writing off of approved defense facilities over a period of 5 years.

'Confused Situation'

Congress is expected to make another try next year at enacting legislation permitting sellers to quote delivered prices and absorb freight in an effort to correct the situation created by the Supreme Court decision outlawing basing-point pricing in the Cement Institute case in 1948.

A Senate commerce subcommittee which has been inquiring into the situation will write the legislation, designed to deal with a "chaotically confused situation" for which it holds the Federal Trade Commission responsible.

Delivered pricing was a major issue in Congress for 2 years, and legislation to make such pricing legal was passed and was sent to the White House early this year. President Truman vetoed the measure on the ground it was so obscurely written as to be uncertain in meaning, but maintained also that the Supreme Court decision did not develop a situation which required remedial action.

The President said, however, that if experience under the decision demonstrated that clarifying legislation was necessary he would be willing to reconsider the matter, and the Senate group proposes to call on him to make good on that promise.

There is no question but that the Cement Institute decision has led to supply difficulties and high prices in some commodities formerly sold over large areas on basing-point prices. The oil industry has not been reported as encountering any difficulty with respect to the distribution of its own products, but producers in many sections of the country have found it difficult to get cement for their new wells because the cement industry has been forced to operate on more or less of a local basis. Highway construction also has been hampered and industrial construction slowed down in some cases for the same reason.

Space Shortage

Washington again is up against the difficulty which plagued it through two world wars—lack of space for the thousands and thousands of new workers who will be needed for the defense program.

This time, the question is made more serious by the threat of possible atom bombing of a city which has no hills to cut one section off from another and with only 3.6 per cent of its buildings even relatively resistant to fires that would be caused by heavy bombing. Fires, according to the Civil Defense Administration, caused 80 per cent of the damage suffered by cities attacked from the air during the last war.

Already, space for government workers is at a premium and in the near future at least one Washington manufacturing plant and a large apartment house now nearing completion will be taken over. PAD Deputy Administrator Bruce K. Brown disclosed last week that his agency cannot be fully staffed until new working quarters are provided, which can be done only by either moving Interior Department employes out of their building, where PAD now is located, or giving PAD space elsewhere.

There is considerable talk of moving key agencies and particularly military "brain" personnel out of Washington to points as far as 20 miles distant as a guard against disruption of the Government by air attack, and Congress is considering a multi-million-dollar proposal to erect buildings for those agencies in Maryland and Virginia.

from coke operations incidental to the steel-expansion program.

A large part of the 1951 supply will be required for the production of styrene for synthetic rubber, but substantial quantities also are used in plastics, aniline, nylon, DDT, detergents, and many chemical products. Even if there were no defense emergency, it was said, new sources of benzene would be urgently needed to take care of rapidly growing demand for plastics and other civilian products.

At the present time, a major portion of the benzene supply is secured from light oil developed as a by-product when coking coal is burned for the manufacture of coke gas for smelting pig iron. Small amounts are being produced, at relatively high cost, from petroleum.

Limitations.—The supply of benzene is limited by the requirements of the steel industry and production facilities have increased only moderately over the past 4 years while demand has increased 40 per cent, and it is estimated that nearly twice the present production will be required by 1955.

The whole thought of NPA officials and industry representatives participating in the discussions was aimed at quick expansion of benzene supplies, and reportedly there was no mention of the construction of coal-hydrogenation plants which Interior Department officials pressed earlier this year as a solution of the problem. It was contended such plants would be expensive in both money and materials and would require 30 months or more for construction, whereas the oil industry could start to increase its benzene output within a few months.

A technical committee set up by PAD is also studying the possibilities of benzene production from oil, and officials expect to work with NPA on the expansion program.

Among those attending the NPA conference were O. V. Tracy, Esso Standard Oil Co., New York; A. B. Hersberger, Atlantic Refining Co., Philadelphia; W. P. Gage, Shell Chemical Co., New York, and C. F. Frenchter, Pan American Refining Co., New York.

New England Fuel

Supplies are better than last year, committee says

WASHINGTON.—New England fuel supplies now are "considerably better" than they were last October when refineries were asked to increase their private stocks of heating oils to guard against a shortage, it was declared last week in the final report of a Senate small business special subcommittee which has been investigating the situation.

Identical reports issued over the

signatures of Senators William Benton of Connecticut, Democratic chairman of the subcommittee, and Leverett Saltonstall of Massachusetts, senior Republican member, however, warned that "continuing vigilance and action by the suppliers to keep these stocks at safe levels over the next several months is essential."

While the subcommittee wound up its inquiry in compliance with a requirement that it report by December 15, both members said the staff will continue to watch developments in the area throughout the winter.

The report also warned that even with the present satisfactory conditions there still remains a possibility of shortages, spot or general, due to weather conditions or an unexpected turn in the international situation.

No assurances.—"Although the fuel subcommittee's investigation has not found reason for undue concern as to the fuel prospects for New England this winter," the two senators said, "no one can properly give complete assurance that fuel supplies would be entirely adequate for any and all eventualities, especially in view of the recent developments in the Far East. As past experience shows there could also be localized spots even with generally adequate supplies."

From October to December, the report said, primary stocks of distillate fuel oils in the East and Gulf Coast areas rose more than 4,000,000 bbl. and are now only 8 per cent below the level of a year ago, in contrast with the October supplies which were 11 per cent less than at the same time in 1949. This improvement was attributed to recent increases in refinery yields of distillate fuel oils which the subcommittee staff recommended in October, and also to relatively mild weather experienced in New England so far this winter.

Extension asked.—Meanwhile, a 2-year extension of the investigation of fuel reserves approved by the Senate during the regular session has been asked by Sen. Joseph C. O'Mahoney of Wyoming, chairman of the Interior Affairs Committee which is conducting the inquiry.

The investigation was called for in a resolution introduced by Sen. Francis J. Myers of Pennsylvania following a congressional study of complaints from the coal industry that heavy fuel-oil imports were raiding coal markets, and originally was to be completed by the end of this year. The committee, however, has been able to make only some staff studies so far, and O'Mahoney would have the committee's authority for the inquiry continued to January 3, 1953.

Plant Concentration

FTC says refining leads most all other industries

WASHINGTON.—The Federal Trade Commission charged this week that concentration has been carried to a greater point in petroleum refining than in 334 of 339 other industries included in a study of "divergence between plant and company concentration."

The commission reached this conclusion by comparing company concentration with plant concentration to arrive at a "divergence index" which in the case of refining was placed at 484.4. Higher figures, ranging up to 653.3, were found only in the case of condensed milk, motor vehicles and parts, steel works and rolling mills, tin cans and other tinware, and cottonseed-oil mills.

"Although there are many small refineries in the field, the petroleum industry as a whole is one of very large plants," the FTC reported. "The average value added per plant is $3,419,800, the eighth highest of any manufacturing industry. Despite this large scale of operations, the plant-concentration curve is only moderately steep, because of the existence in the industry of a relatively large number of big plants. The 20 largest plants produce 32 per cent of the value, and the 50 largest, 62 per cent.

Company basis.—"On a company basis, however, the degree of concentration is much greater. The industry's 437 plants are owned by only 277 companies, with an average of 1.58 plants per company. This average for the industry as a whole is a composite of a few large multiple-plant companies on the one hand and many small, single-plant refiners on the other. The 8 largest companies in the industry own 92 petroleum refineries, and the 20 largest own 139. The average number of refineries per company for the remainder of the industry is only 1.16. As would be expected from this centralization of multiple-plant operations, the company-concentrated curve, which rises steeply through the first 20 units, flattens out very sharply thereafter. The sustained steepness of the company curve through the first 20 concerns is almost unique among manufacturing industries. As a result of this consistent steepness of the company curve, accompanied by the more inclined slope of the plant curve, the industry has a divergence index of 484.8 per cent, with the difference between plant and company concentration reaching its maximum at 20 units. Whereas the 20 largest plants produce 32 per cent of the industry's value, the 20 largest companies account for 83 per cent."

Other industries.—In other industries, the commission found that oil-field machinery and tools had a divergence index of 110, with the four largest companies accounting for 33.2 per cent of the value.

The study upholds, for certain industries, the view that a high degree of company concentration is merely the inevitable consequence of the requirements of modern technology and, for other industries, the opposing position that company concentration is not based upon large plants and could be substantially reduced without impairing whatever productive efficiency large plants achieve; in short, the commission said, "American industry presents the picture of a 'mixed economy.'"

New Community Under Construction

This is a view of the signboard telling of the new community which Richfield Oil Corp. is sponsoring near the South Cuyama field of California. Streets, hard-surfaced with curbings, have already been completed, and about 40 homes are nearing completion. There will be a total of 320 homes for oil-field workers.

Oil-Supply Problems

Transportation, refining need attention to assure free flow of hydrocarbons for all needs, Brown tells I.O.C.C.

Leigh S. McCaslin, Jr.

HOUSTON.—Only "certain activities" in transportation and refining are necessary at present to assure a "free flow of hydrocarbons" to the military and the civilian population, Bruce K. Brown, newly appointed deputy administrator of the Petroleum Administration for Defense, asserted here.

Speaking before the Interstate Oil Compact Commission, Brown warned, however, that other steps may have to be taken at a later date. Specifically, the transportation and refining problems needing immediate consideration, according to Brown, are:

1. The question of additional tanker transportation needed by the Military Sea Transportation Service.
2. The evaluation of numerous pipeline projects in the light of supply needs and materials available.
3. The evaluation of all transportation available in the light of an over-all supply program designed to meet any and every eventuality.
4. Increasing refinery output of needed military petroleum products—particularly aviation fuels and Navy diesel fuel—from existing facilities.
5. The planning of and approving of additional refining facilities for aviation fuels, Navy diesel fuel, and other products.

The PAD deputy administrator told the I.O.C.C. that while only these specialized actions are necessary to assure products from the industry, a big job exists in supplying materials to the industry. Brown said that although the shortage of oil-country tubular goods receives the most public attention, other shortages or feared shortages exist.

Matters of concern.—He said that the following are matters of concern:

Tank-car-construction programs, privately financed and ready to go, are slow in execution.

The rehabilitation of World War II 100-octane gasoline units is rendered difficult by the unavailability of certain alloys.

New pipe-line projects for both oil and gas will need large quantities of pipe.

An expanded barge-construction program is anticipated.

American oil companies operating abroad must have special attention for their needs because of problems of delivery, inventory, and "red tape."

Manpower.—Brown placed manpower on a par with materials as necessary to insuring a properly functioning oil industry. He also emphasized that it would be "foolish indeed" to assume that any particular branch of the industry should be given an "overwhelming 'first priority'" for either manpower or materials.

When the present emergency passes, the PAD will go out of existence, Brown assured his listeners. Also, every effort will be made to avoid any impairment of what Secretary of Interior Oscar L. Chapman calls "the free enterprise competitive system that prevails in the petroleum industry."

Brown inserted a strong plea for help from the industry in providing "volunteer expert talent" to staff PAD. He promised that "we will keep down our calls for industry personnel to the minimum feasible under the circumstances."

Conservation.—Another outstanding feature of the 3-day I.O.C.C. meeting was an eight-man panel of oil-bank vice presidents discussing "Viewpoint of the Banking Industry on Conservation." While the discussion was overwhelmingly in favor of good conservation practices, a warning was sounded that it might be possible to carry conservation beyond "economic prudence." In illustration of this point, discussion developed on the proposal which was before the Texas Railroad Commission last week to reduce the present maximum gas-oil ratio of 2,000 to 1 down to 1,000 to 1. (This proposal was rejected at the commission hearing which was held the day following the I.O.C.C. panel. *See "Southwest" in this issue.)*

High points of the bankers' panel, which many interpreted as a tribute to the work of the Texas Railroad Commission and other conservation bodies, included the following: Oil financing has advanced from the short-term loans of early days to a period of larger and longer-term loans. This has been brought about by many factors such as enforced proration, better estimation of reserves, unitization of common reservoirs, the Connally Hot Oil Act, deeper production with resultant higher costs, and increased knowledge in the field of petroleum engineering.

Although some claim that market-demand statutes are price-fixing measures, the bankers presented a detailed chart to disprove this claim. This chart compared average posted crude prices since 1919 with the commodity price index during the same period. It revealed that the two followed the same general pattern.

OIL-MINDED GOVERNORS.—Three chief executives who attended the Interstate Oil Compact Commission meeting in Houston last week. Left to right: Sidney S. McMath, Arkansas; Allan Shivers, Texas; and Roy Turner, Oklahoma.

Willing to appear.—Lt. Gen. Ernest O. Thompson of the Texas Railroad Commission asked the bankers if states with prospects of oil production should enact conservation statutes before the production was found. The panel answered that this would help the banking profession tremendously. The bankers also indicated a willingness to appear before the legislatures of such states in the support of conservation laws.

(During the meeting of the I.O.C.C.'s legal committee, four states asked for help in setting up conservation laws. They were Colorado, Wyoming, Washington, and Nebraska.)

Members of the banker's panel included: Eugene McElvaney, vice president, First National Bank in Dallas; R. Elmo Thompson, vice president, First National Bank & Trust Co., Tulsa; Herbert Pryor, vice president, Mercantile National Bank of Dallas; John R. Scott, vice president, Republic National Bank of Dallas; L. B. Herring, vice president, Second National Bank of Houston; George L. Nye, vice president, City National Bank of Houston; E. O. Buck, vice president, National Bank of Commerce of Houston; and E. M. Reed, vice president, First National Bank of Houston.

Resolutions.—Among the resolutions adopted by the I.O.C.C. during its meeting were: Commendation of Secretary of Interior Oscar L. Chapman and a pledge to support him in his "discharge of responsibilities respecting oil and gas." A request that the Bureau of Mines do everything possible to make the results of its friction-factor studies for gas and gas-

condensate wells available to the states and to the industry.

Gov. Allan Shivers of Texas was elected chairman of the compact at the closing session. He succeeds Gov. Roy J. Turner of Oklahoma. Other officers chosen include Norman V. Kinsey of Louisiana, first vice chairman; J. Paul Jones of Pennsylvania, second vice chairman; and Earl Foster, secretary. The spring meeting of the group will be held in Santa Fe, N. M., in late April or early May.

Southwest Gas

Export may cause shortage in area, FPC member says

HOUSTON.—A member of the Federal Power Commission sounded a warning here last week that there is a possibility the Southwest will expand its export of natural gas to such an extent as to endanger the supply to local consumers.

Speaking at the winter meeting of the Interstate Oil Compact Commission, Harrington Wimberly asserted: "This momentum of expansion of natural-gas pipe lines cannot continue without considering the impact it will have on local industrial expansion and the millions of home owners in growing cities of the Southwest a dozen years from now."

Wimberly emphasized that he was not advocating or suggesting any specific policy for state authorities to follow in the matter. However, he said that if "exploitation of markets" exceeds available reserves for these markets, sound conservation practice will suffer. He added that a sound policy on the interstate movement of gas is just as important to natural-gas consumers in the East and Midwest as to the people of the Southwest.

Movement doubled.—The FPC member cited Bureau of Mines figures to show that interstate movement of natural gas doubled in the period 1945 to 1949. Total interstate movement of natural gas was slightly over 1 trillion cubic feet for the year 1945, increasing to 2 trillion in 1949. Approximately 75 per cent of this 1949 total was supplied by the states of Texas, Oklahoma, and Louisiana.

Capacity of southwestern gas systems engaged in interstate movement of gas has shown an even greater increase. On January 1, 1946, these pipe lines had a total daily capacity of 2.7 billion cubic feet. Today, according to Wimberly, the total installed and authorized capacity of all the lines taking natural gas from the Southwest is approximately 9.4 billion cubic feet daily. Depending upon the defense effort, this capacity will probably be reached by late 1953 or 1954. At that time, Wimberly estimates, the "interstate take" of natural gas from the Southwest will be "well above" 3 trillion cubic feet annually.

Wimberly pointed out that this 3 trillion total just about equals the total marketed production of natural gas in the states of Texas and Louisiana in 1949. He adds that the interstate pipe lines either own or have under contract approximately one-half the known reserves of gas. This estimate is based on a reserve figure of 180 trillion cubic feet.

More strict.—The Oklahoma member of the FPC predicted that the regulatory body may be much more strict in the future in requiring firm contracts on gas reserves before issuing a certificate. This will be necessary, he believes, because the interstate-pipe-line companies have "the cream of all natural-gas reserves available."

In his preliminary remarks, Wimberly mentioned briefly the question of the scope of jurisdiction of the FPC in the regulation of the natural-gas industry. He took no side on the issue, but did say "the sooner that either the highest court in the land or the Congress clarifies the important question of whether the producers of natural gas who sell to interstate-pipe-line carriers are natural-gas companies and are thereby subject to rate regulations by the FPC, the better it will be for the commission and the industry."

Dip Logger Unveiled

Carter Oil Co. has now licensed for industry use this new tool with which it has been experimenting quietly for many months. It is used for determining the dip and strike of underground formations from a single well bore. As the tool is pulled up the hole the three arms follow the ledges and niches formed on the wall where drilling mud has eroded softer formations more than hard. The variations in hole size are recorded continuously at the surface along with inclination, compass direction, and depths. From these data, with the aid of a model-like device, dips and strikes can be computed rapidly and accurately. The usefulness of this tool was discussed in The Oil and Gas Journal, October 19, page 151. In this picture are F. G. Boucher and A. B. Hildebrandt, Carter research engineers who played major roles in the development of the instrument.

U.S. Production

Crude-output increase not required, I.O.C.C. told

HOUSTON.—No increase in United States crude production to meet demand will be required in the next few months, H. B. Fell, executive vice president of the Independent Petroleum Association of America, said here last week.

Speaking at the winter meeting of the Interstate Oil Compact Commission, Fell qualified this statement on the condition: "If the importing companies increase imports during the year 1951, as they have announced publicly." The I.P.A.A. official said that it was his personal opinion that the industry can meet any producing demands made upon it in the months ahead. However, a "continuous and aggressive" exploration and development program must be carried on to provide for any emergency, he feels.

For the benefit of the compact members, Fell interpreted supply and demand developments which have taken place since October 2. This is the date of the most recent supply and demand report of the I.P.A.A.'s economics committee of which Fell is chairman. He said, in part:

"In its October report, our committee forecast a total consumptive demand for all oils for the fourth quarter of 1950 averaging 7,057,000 bbl. daily. The committee anticipated a slight decrease in total stocks of crude oil and refined products during that quarter and estimated that as of December 31, the total stocks would be 579,500,000 bbl. As of the week ended November 2, 1950, based on American Petroleum Institute figures except for Bureau of Mines figures on crude oil, the total stocks were about 601,000,000 bbl., or approximately 21,500,000 bbl. in excess of the estimated stocks as of December 31, 1950. During the month of December, due to heavy demands, total stocks normally decrease.

Demand figures.—"The following table of estimated total demand includes figures taken from the October report of this committee covering the fourth quarter of 1950 and the first three-quarters of 1951, together with figures of total demand taken from the forecast of total demand

issued by the Bureau of Mines of the U. S. Department of Interior on November 28, 1950:

TOTAL DEMAND (BARRELS DAILY)

	Economics Committee I.P.A.A.	Bureau of Mines
1950—		
Fourth quarter	7,057,000	7,086,000
1951—		
First quarter	7,224,000	7,300,000
Second quarter	6,633,000	6,791,000
Third quarter	6,868,000	7,043,000

"You will note from the preceding table that although the forecast of our committee was released early in October, and the forecast of the Bureau of Mines was not released until November 28, 1950, that for the fourth quarter of 1950 and the first quarter of 1951 there is very little difference in the forecasts. In the second quarter of 1951 the forecast of the Bureau of Mines is 158,000 bbl. per day greater than our forecast and for the third quarter of 1951 is 175,000 bbl. per day greater than our forecast. The differences in these figures, in making forecasts so far in advance, are relatively small and in view of the probable increase in military operations and industrial activity, that now seems more definite, I am inclined to believe that our committee might increase their forecast of total demand for the second and third quarter to figures in excess of the forecasts made early in October."

U. S. Tankers

Fleet is faster, 2,630,000 tons larger than in 1939

WASHINGTON.—The United States today has a tanker fleet 2,630,000 tons larger and 20 per cent faster than the fleet of 1939, it was reported this week by the joint committee for the American Merchant Marine.

The combination of increased tonnage and speed gives an almost doubling of the 1939 capacity although actually, because of the much larger percentage of tankers in long-haul foreign trade, the expansion is much less.

The joint committee, which is composed of representatives of every activity having an interest in merchant-marine matters, reported that as of November 1, last, there were 439 active tankers under the American Flag with a deadweight tonnage of 6,537,900 compared with 352 tankers of 3,908,000 tons in 1939. However, the number of tankers in coastwise service had declined from 304 to 269 while that in foreign trades increased from 48 to 170.

A survey of world merchant-vessel construction in mid-1950 by the committee showed there was 5,410,300 tons of ocean-going tankers of 1,000 gross tons or more building or on order, but only 90,000 tons of this was in the United States.

Norway leads.—The greatest construction reported was for Norway, with 1,898,600 tons, followed by the United Kingdom, with 1,274,500 tons. Other construction included: 308,400 tons for France, 288,700 for Sweden, 71,900 for Japan, 160,200 for Denmark, 261,100 for Panama, 2,600 for Germany, 71,300 for Italy, 48,400 for the Netherlands, 214,400 for Argentina, 166,700 for Brazil, 31,600 for Canada, 159,100 for Liberia, 22,800 for Poland, 42,700 for Spain, and 297,300 tons for which the registry could not be determined.

There was twice as much tonnage under construction for tankers as for freighters and more than five times as much as for passenger vessels. Tankers accounted for approximately 60 per cent of all vessels under construction.

U. S. fleet.—The committee found that the United States Flag active seagoing merchant marine is notably larger in number of vessels and in total tonnage than in 1939, but the improvement was due almost entirely to the tanker segment, for it is woefully deficient in fast, modern passenger ships quickly convertible to troop transports in event of emergency and the domestic merchant fleet is less than one-half its prewar size and importance and even more deficient in the coastwise and intercoastal trades.

Texas-California Line

Los Angeles firm seeks approval of 24-in. crude line and parallel products carrier from Texas to West Coast

D. H. Stormont

LOS ANGELES.—Plans for a $100,000,000 West Texas-California pipe-line project involving a 24-in. crude carrier and a paralleling products line were announced here last week. The project was made known when a local company, the Progress Co., filed for an authorization certificate with the Petroleum Administration for Defense in Washington.

If approved, the plans call for construction of a 24-in. crude line of 250,000-300,000 bbl. daily capacity from the vicinity of Hobbs, N. M., to the harbor area of Long Beach. Crude would be gathered through a system fanning out from the initial station to points in West Texas and Southeast New Mexico.

Paralleling the main line to California, some 1,100 miles, would be a 10¾-in. products line of 65,000 bbl. capacity to reach markets in Arizona and New Mexico from a refinery in that area to be served by the crude line.

Local backing.—Sponsors of the project are Marc D. Leh and David E. Brown, coowners of Progress Co. Progress Pacific Pipe Line Co., a California corporation, would build and operate the lines. It would be privately financed and would operate as a common carrier. Its cost is placed in the vicinity of $100,000,000 to $120,000,000. Engineering and contracting of the line, according to Leh, would be by Ford, Bacon & Davis of New York.

Leh until 1938 was general sales manager for General Petroleum Corp. He and Brown were the first to undertake large-scale operations of serve-yourself filling stations in the Los Angeles area. Currently the company is not engaged in any oil operations, Leh said.

In discussing the proposed lines, Leh said the project had been in the planning stage for a number of years, with the idea of its being constructed in 1953. Should PAD approve it as an emergency project, however, and the necessary steel made available, the project could be under way in about 60 days, he stated. Sufficient crude to keep the 24-in. line fully supplied has been arranged for in the Permian basin, he added.

Double purpose.—Leh explained the proposed common carriers would simultaneously alleviate two current ills—West Texas' excess crude-producing capacity and California's need for more crude supplies. In times of national emergencies, he pointed out, the system's flexibility would be decidedly advantageous.

If, for example, much of California's refining capacity was damaged by enemy action, the line could be reversed and California crude moved to inland refineries. The products line could continue to supplement refinery capacity still in operation, he explained.

Certificate for Line Asked

WASHINGTON.—The authorization asked of the Petroleum Administration for Defense by Progress Pacific Pipe Line Co. is a certificate permitting amortization of the investment over a period of 5 years.

PAD previously had under consideration an application for accelerated amortization filed by a group of 50 independent Texas producers who propose to build a similar crude pipe

line with a $50,000,000 refinery in Arizona.

The Progress project was originally planned for 1953, but the application was filed at this time, it was explained, because the company believes the pipe line might be needed in the defense program.

No restrictions.—There are at present no restrictions on the building of petroleum pipe lines, provided their backers have the necessary financial ability and are able to secure delivery of pipe and equipment. However, companies now planning such projects can secure tax advantages if they can show they will contribute to the defense program, and can write the investment off over a period of 5 years instead of the normal life of the facilities under the provisions of the revenue bill passed by Congress 3 months ago.

Gas for Northwest

2,100-mile line with capacity of 350,000 M.c.f. daily is planned from Texas Gulf Coast to Pacific Northwest

Kenneth B. Barnes

HOUSTON.—Plans for a natural-gas pipe line from the Texas Gulf Coast to the Pacific Northwest, with a supply line from western Canada and a delivery line to eastern Canada, are under way by a group of four related companies.

The United States portion of the system will be owned and operated by Pacific Northwest Pipe Line Corp., Houston. The line is being designed for an initial capacity of 350,000 M.c.f. per day, and the total cost of the system is estimated at $192,000,000. The airline distance from the center of the Texas coastal gas fields to the terminus of the main line is about 2,100 miles.

Canadian lines.—An important part of the system is a branch line running mostly south of the Canadian border to the coast to move gas from Pincher Creek field and other gas-supply areas of southwestern Alberta Province.

Prairie Pipe Lines, Ltd., an Alberta corporation, and Prairie Transmission Lines, Ltd., a Dominion-chartered corporation, have applied to the Alberta Board of Conservation to export natural gas for the Pacific Northwest market. Both are totally owned Canadian subsidiaries of Pacific Northwest Pipe Line Corp.

Prairie Transmission has also made a complete survey of the eastern Canada provinces of Ontario and Quebec and has proposed to construct a system 580 miles in length from Windsor, Ont., to Montreal. In this connection, Pacific Northwest proposes to transport the natural gas for Prairie by constructing a lateral line 1,000 miles from a point on its system in southwestern Oklahoma, to connect with Prairie's eastern Canadian system at Windsor.

Fish Engineering.—The fourth company in the project is Fish Engineering Corp., Houston, which has a contract for the design, engineering, and construction. Ray C. Fish is president of Fish Engineering and also of Pacific Northwest, and in an interview with representatives of The Oil and Gas Journal this week he outlined the program as follows:

Pacific Northwest is a Delaware corporation formed to own and operate a gas transmission system to serve the Pacific Northwest area of the United States and Canada. It has two totally owned Canadian subsidiaries, Prairie Pipe Lines, Ltd. (Alberta corporation), and Prairie Transmission Lines, Ltd. (Dominion corporation).

Pacific Northwest has pending with the Federal Power Commission an application for a certificate to construct its pipe line system, and Prairie Pipe Lines, Ltd., has pending before the Board of Conservation of Alberta its application for the export of a minimum of 100,000 M.c.f. per day of natural gas from Alberta.

The company has negotiated with consuming markets for the sale of gas, and these markets agree to purchase gas from Pacific Northwest as soon as gas can be made available. Fish Engineering Corp., acting for Pacific Northwest, has contracted pipe requirements from Kaiser Steel Corp. and Consolidated Western Steel Corp., with delivery scheduled to start in the late spring of 1951 and the system is planned to begin operation late in the fall of 1952.

The calculated initial requirements of Pacific Northwest for natural gas are 350,000 M.c.f. per day, and at the end of the first 5 years of load growth the requirements are expected to be 500,000 M.c.f. per day.

Pacific Northwest has arranged for complete financing, and testimony has been submitted to the Board of Conservation of Alberta by White, Weld & Co., Kidder, Peabody & Co., and Dominion Securities, Ltd., that the company is prepared to finance the project.

The project is considered to be essential to the over-all defense program by furnishing another source of fuel to the highly populated and industrialized section of the Pacific Northwest. In addition to serving utilities of various cities, the system will also serve vital industries and the atomic energy plants in Washington and Idaho.

Defense aspect. — In connection with the last point, C. D. Howe, Minister of Trade and Commerce, Canadian Dominion Government, wrote the Alberta Conservation Board during its recent natural-gas hearing at Calgary:

"I have recently been advised by the chief of the international program of the United States Munitions Board that the board is seriously concerned about the lack of fuel in the Pacific Northwest section of the United States. The wartime industrial development, together with the diversion of normal oil supplies, has seriously accentuated the scarcity.

"It is suggested that the availability of large supplies of natural gas

Map showing route of proposed Texas Gulf Coast-to-Pacific Northwest natural-gas line.

in the Province of Alberta is one source from which the scarcity of fuel and power in the Pacific Northwest could be alleviated. I am asked the question whether these supplies can be made available.

"The letters indicate that if the supplies are not available, immediate steps will be taken to supply this area from Texas sources of natural gas. You are aware that an application has recently been filed with the Federal Power Commission of the United States of America for permit for a pipe line from Texas to the Pacific Northwest.

"This Government is in the position that we cannot answer any questions until Alberta decides whether gas from that province will be made available for export outside the province. There would seem to be a great urgency for a decision one way or another.

"I see no prospects on a line being built from Alberta to the Canadian Northwest, unless that line is to be extended from Vancouver southward to serve the Pacific Coast cities."

Route chosen.—The Pacific Northwest pipe-line system, handling gas from Texas and other states and from the gas fields of southern Alberta, will originate in the Texas Gulf Coast area, pass through the Rocky Mountain area of Colorado and Wyoming, the Snake River Valley of Idaho, the Columbia River Basin of Oregon and Washington, and terminate at Portland, Ore., and Vancouver, B. C. It will make available natural-gas service along its route to cities and areas not now served or partially served, including Salt Lake City; various cities not now served in Idaho, Oregon, and Washington, including Spokane, Seattle, Portland, Tacoma; and Vancouver, B. C. It will also render service to the AEC plants located at Hanford, Wash., and Arco, Idaho, and various essential defense industries.

The initial designed capacity is for 350,000 M.c.f. per day of gas, with 100,000 M.c.f. per day being obtained from Alberta Province and 250,000 M.c.f. per day being obtained in the United States. The estimated market requirements of the above areas during the first 5 years of load growth approximate 500,000,000 cu. ft. per day. In addition, the system crosses substantially all of the major gas transmission systems now operating. This makes these respective systems potential gas customers of Pacific Northwest. It is estimated that the potential market available to Pacific Northwest approaches one billion cubic feet of natural gas per day.

Canadian advantages. — Speaking as president of Prairie Pipe Lines, Ltd., and Prairie Transmission Lines, Ltd., Fish said the plans offer Canada these advantages:

1. Canadian gas will first be made available to Canadian markets.
2. Prairie offers to make available surplus gas to the highly populated and industrial area of eastern Canada (6,000,000 population in market area).
3. Prairie and its parent corporation Pacific Northwest can make available extensive United States markets for Canadian gas to a limit considerably beyond any estimate that has been yet considered possible.
4. The immediate all-Canadian market available to Prairie will range from a minimum of 100,000 M.c.f. per day to 325,000 M.c.f. per day.
5. The extensive market made available by Prairie will stimulate extensive development for natural gas in Alberta.
6. Prairie and Pacific Northwest propose to undertake extensive development for the discovery and production of natural gas in Alberta.
7. Prairie agrees to construct a grid system connecting Alberta fields, either severally or jointly with others, whenever such a grid system is required and justified.
8. Prairie and Pacific Northwest, subject to proper authorization by their respective governments, propose to construct the pipe-line system so that it will be ready to deliver natural gas to the market by the fall of 1952.

Texas Allowable

Railroad Commission orders continuation of present oil output for January; gas-oil ratio rule to be maintained

Joseph A. Kornfeld

AUSTIN.—Continuation of the present producing rate for the month of January and maintenance of the existing gas-oil ratio rule were ordered last week by the Texas Railroad Commission.

The commission voted to retain the present producing schedules throughout the state, which call for 20 producing days generally for all fields, 19 days for Fullerton, and 13 days for Willamar. The net effect of this action is an unchanged permissible level for January since both December and January have 31 calendar days. (The daily average "allowable" is developed from the ratio of producing days to calendar days.) However, by January 1, the actual allowable for December will have risen an additional 25,000 bbl. per day over the present official quota due to new wells which will be completed during the remainder of the month.

The average allowable for December for Texas was 2,536,946 bbl. daily from 124,614 wells. However, crude-oil production for the week ended December 9 was 2,375,425 bbl. This compares with the January estimate of market demand by the Bureau of Mines of 2,395,000 bbl. daily, an increase of 15,000 bbl. daily over its December estimate.

Purchaser nominations for January totaled 2,641,731 bbl. daily, an increase of 34,563 bbl. daily over the December figure. Only purchasers to ask for more oil during January were Humble Oil & Refining Co. and Shell Oil Co. J. A. Neath and Herman P. Pressler, Houston, both with Humble, asked for 21 producing days in all areas of the state except East Texas and certain West-Central Texas counties which were requested on a 20-day basis.

West-Central Texas. — Pressler cited the existence of pipe-line conditions which prevented the movement of more oil than is being produced at this time from Fisher, Haskell, Jones, King, and western Shackelford counties. He said that Humble was willing to part with some connections in the area but that Onyx Refining Co., Abilene, was the only other buyer. It was developed that Onyx buys 4,000 bbl. daily for its Abilene refinery and sells 14,000 bbl. per day additional oil to Magnolia Pipe Line Co.

Don Crites, Houston, representing Shell Oil Co., said that his firm nominated 22 producing days for January, the same request as that made for December. Shell wants 7,000 bbl. daily of additional oil from its present connections, Crites said. However, Commissioner Ernest O. Thompson observed that the effect of adding 2 more producing days to next month to all fields in the state would result in an increase of 180,000 bbl. daily in the permissible.

After the commission announced the January order, Neath said: "Humble still wants more crude oil and we might be in before Christmas to ask the commission to help us get it."

Storage situation.—In a statement issued prior to the hearing, Chairman William H. Murray, Jr., pointed out that crude-oil stocks for the nation stand at 247,747,000 bbl. However, Commissioner Olin Culberson said that a recent report of the National Petroleum Council showed that only 63 per cent of the aboveground storage is available for processing and commented that "every effort should be made toward piling up this storage against the time when it will be needed."

Fearful of the effects of an impending emergency on the volume of storage crude available for processing, Neath warned the commission: "If we get into an emergency, I fear we will be criticized for not moving

oil out of West Texas and getting it to the coast."

Chairman Murray replied to Neath and asked him to prepare a report to the commission as to whether Humble could obtain its oil needs or why the other companies could not take more oil. Then the allowable could be raised the day following the hearing in January. Neath countered that 17 days of capacity would have been lost by the next hearing.

Gas-oil ratios. — More than 2 hours were devoted to a discussion of the proposed rate of 1,000 cu. ft. per bardel for gas-oil ratios to apply to those fields which have no special ratio rule at this time. Currently, the commission permits operators to produce up to 2,000 cu. ft. per barrel on oil wells before imposing an allowable penalty.

Ira Butler, attorney representing independent operators, Gillis Johnson, and Sen. Keith Kelly, all of Fort Worth, suggested that the present rule be left unchanged. They believed that new fields should be placed under the 2,000-cu. ft. rule until a hearing is held.

The commission decreed that the statewide rule would not be changed but advised operators that testimony covering every new field hearing should include data as to what the gas-oil ratio should be. It warned producers that the ratio of 2,000 cu. ft. per barrel "would not be automatic" in new fields.

Change opposed.—Opposition to the proposed change in the ratio rule came from the gas companies which depend to a great extent on casinghead gas as a source of supply. They explained that they had made commitments based on existing ratio limits of 2,000 cu. ft. per barrel and that their available supplies from existing connections would be reduced sharply if a major slash in the permissible ratio limits were made at this time. Another factor influencing the decision of the commission to abandon the proposed rule was the effect that a major change in the ratio would have on the available supply of natural gas in the event of an accelerated national gas emergency.

Paul Kayser, Houston, president of El Paso Natural Gas Co., complimented the commission on its action. He stated that his company had contractural obligations covering 2,000,000 M.c.f. of residue gas in West Texas. He said that El Paso is currently handling 650,000 M.c.f. per day out of the Permian basin, had made plans for handling 850,000 M.c.f. daily in 1952, and 875,000 M.c.f. daily during 1953.

New chairman.—Culberson was elected chairman of the commission for the next 2 years succeeding Murray. His election came after nomination by Thompson, senior member of the commission.

The next statewide oil-proration hearing will be held on January 17 in Houston.

Allowables by Districts

Average calendar day allowable for Texas fields for January 1, 1951:

	Allowable for January (bbl./day)
Dist. 1 (Southwest)	34,347
Dist. 2 (Southwest)	146,082
Dist. 3 (Gulf Coast)	444,628
Dist. 4 (Southwest)	229,152
Dist. 5 (Eastern	44,053
Dist. 6 (outside East Texas field)	99,078
East Texas field	272,633
Dist. 7-B (West Central)	86,710
Dist. 7-C (West)	75,640
Dist. 8 (West)	801,887
Dist. 9 (North Central)	195,442
Dist. 10 (Panhandle)	107,294
Total	2,536,946

MID-CONTINENT

Research Lab Planned

A new research center will be constructed in Tulsa by Stanolind Oil & Gas Co. provided materials are available and if no further restrictions are placed on building because of the defense program, the company announced this week.

Preliminary plans have been completed and the firm is preparing to go ahead with the program, erecting facilities on an 80-acre site which was acquired in 1948. Construction is scheduled to begin in the spring.

The new center will house a staff of more than 350 research personnel and will be one of the industry's most modern and complete research laboratories. Shreve, Lamb & Harmon Associates, New York, is the architect.

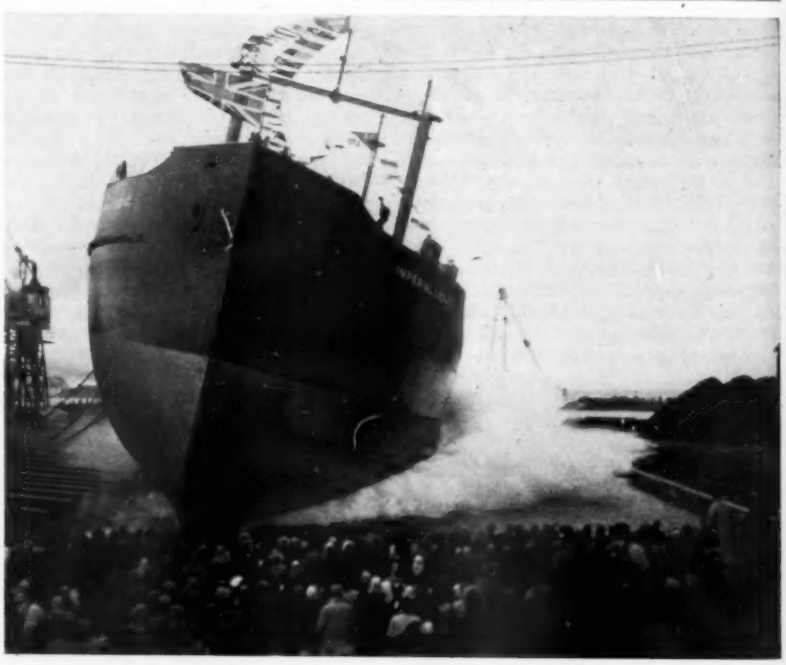
Stanolind's expanding research program has outgrown the present laboratory facilities, making necessary the construction of a larger research center, the company said.

Engineers Go to School

Production and geological engineers of Sunray Oil Corp. attended a special 4-day school this week on electric logging and log interpretation.

Proceeding on the theory that a correctly interpreted electric log of a well contributes a great deal toward the well's proper and successful completion, Sunray retained Dr. R. G. Hamilton and Louis Chombard to instruct engineers and geologists on methods of solving every-day problems encountered in interpreting logs.

First 3 days of the course covered



New Canadian Tanker

The vessel being launched here will be moving crude oil from Alberta fields to Ontario refineries by next spring. It is the Imperial Leduc, named after Canada's first major postwar discovery, which was launched recently at Collingwood Shipyards in Canada for Imperial Oil, Ltd. Its sister ship, Imperial Redwater, was launched November 18. They will transport crude oil eastward on the Great Lakes from the Superior, Wis., terminal of the newly completed pipe line from Edmonton. The Imperial Leduc was christened by Mrs. N. E. Tanner, wife of Alberta's minister of mines. The two ships are the world's largest fresh-water tankers.

fundamentals required to develop and illustrate basic concepts of self-potential and resistivity measurements and interpretations. The last day was spent studying actual well logs and solving problems.

GULF COAST

Tidelands Refund

Texas court orders return of rentals paid to state

AUSTIN.—The State of Texas received another defeat in its battle for the tidelands last week.

The Texas Supreme Court supported the claim of two oil companies for refund of $123,360 in tidelands rentals paid to the state under protest while the tidelands were in litigation. These were paid on November 7, 1949, as annual rental on 89 leases on 123,360 acres of land lying in the Gulf of Mexico. Other companies had paid a total of $284,971 into a treasury suspense account as rental on leases bought on November 7, 1947.

The court issued a mandamus directing Land Commissioner Bascom Giles and other state officials to return the money to Ohio Oil Co. and Melben Oil Co.

Associate Justice John H. Sharp of the Texas Supreme Court stated that the future status of the leases in question was not decided in the Ohio-Melben case. In addition, the Texas court raised the possibility that "an arrangement may be made between the United States and Texas with respect to the tidelands of Texas, and in that event the leases here would be recognized."

Judge Sharp wrote an opinion that the effect of the federal court's judgment in the tidelands case so far is that "they (the state) had no authority to execute the oil and gas leases in question."

State attitude.—Atty. Gen. Price Daniel declared the state court decided only that the School Land Board did not have the right to collect rent while the courts disputed the federal-state title.

"The opinion didn't say the companies will never have to pay," the attorney general explained. "If Congress confirms the state title or state leases, they may some day have to pay the rent."

Three years ago, the School Land Board sold mineral leases on approximately 400,000 acres lying beyond the low-tide mark. Most of the acreage lay inside the 10½-mile offshore belt which the state claims under its annexation agreement with the United States. However, a few tracts were situated further out on the Continental Shelf.

Included in the 10½-mile zone are 2,608,774 acres. The entire shelf contains 17,706,000 acres.

ALONG THE GULF

Leigh S. McCaslin, Jr.

Swamp to Mountains

HOUSTON.—The low, swampy region of Louisiana is slowly building itself up until some day it will become a mountain range comparable to the Rockies. There is no immediate concern, however, as the authority for this statement says that the change will occur in a matter of many, many millions of years.

Speaking before the Geological Society of America, R. Grover Murray, of Louisiana State University, described sedimentary volumes in the gulf coastal plain. He said that in the last 125,000,000 to 130,000,000 years, the United States and Mexican shores of the Gulf of Mexico have received through heavy drainage approximately 1,500,000 cu. miles of sedimentary rocks. This is a quantity sufficient to build five piles of dirt, each a mile square, from the earth to the moon and still have a little left over.

These sediments extend approximately 200 miles inland and from 50 to 150 miles farther out from the modern shoreline beneath the waters of the gulf. A line drawn through Del Rio, Monterrey, San Antonio, Austin, Fort Worth, Dallas, Shreveport, Little Rock, Cairo, Memphis, Tuscaloosa, Montgomery, and Columbus represents the distance dry land has been extended seaward, primarily by deposition.

Aluminum-Plant Sites

Aluminum-company officials are still scouting the Gulf Coast area for possible sites for reduction plants. The area's supply of natural gas is the magnet. J. L. Reynolds, vice president of Reynolds Metals Co., is looking for a place to build a $75,000,000 installation. Also looking is Kaiser Aluminum & Chemical Co., which just recently entered into a contract with the Government to furnish an additional 100,000 tons of aluminum annually.

The proposed reduction plants would convert aluminum oxide into finished aluminum. Aluminum oxide is derived from the raw ore, bauxite. Kaiser performs this operation at Baton Rouge and Reynolds has the world's largest such plant in Arkansas.

Until recently, hydroelectric power has been used almost altogether in the production of aluminum. However, Aluminum Co. of America opened a huge plant at Port Lavaca, Tex., a few months ago, utilizing natural gas as the basic power source. This step was made possible by the design of some new large radial-type gas engines.

Fuel Oil Is 'Tight'

The big winter storms in the East are causing fuel oil to become a little "tight," Gulf Coast jobbers say. However, the biggest shortages are those of tank cars and barges in which to ship products.

Cold weather in the East, plus the Railroad Commission's allowable slash in the Canyon reef fields of West Texas, will probably result in increased crude production for the state in the future. The commission this week in Austin, however, set January allowables on the same level as for December.

Gulf Coast Plagues

Fires and explosions have been abnormally numerous in recent weeks for the Gulf Coast oil and gas industry. A number of refinery fires, two pipe-line blasts, and an oil-well explosion have been among the disasters.

Most recent difficulty was a drilling well in the Point a la Hache field about 50 miles south of New Orleans. Richardson & Bass 18-E Humble-Delacroix Corp. caught fire when high-pressure gas and sand cut a choke line. It was extinguished after burning for about a day and causing about 30 per cent destruction of the $1,000,000 swamp barge being used on the hole.

Recently two big cross-country gas pipe lines experienced explosions. Tennessee Gas Transmission Co. had a blast in Mississippi and Transcontinental Gas Pipe Line Corp. had trouble in New Jersey.

Gulf Coast refineries have had considerable difficulty. On November 15 there was a series of explosions in the high-pressure-storage area at Gulf Oil Corp.'s Port Arthur refinery. Earlier, Humble Oil & Refining Co. had a fire in the exchanger area near a cat cracker. A couple of months ago The Texas Co. refinery at Port Arthur suffered considerable fire damage, and in October Pan-Am Southern Corp. had a pump-room explosion at its El Dorado, Ark., plant.

PERSONALS

Far East Veteran

Company credits Davidson with success of program

A LARGE share of the credit for developing the Far East refining operations of Standard-Vacuum Oil Co. belongs to Harold M. (Hal) Davidson, manager of the company's manufacturing department.

Davidson spent 11 years in Sumatra prior to the war at the Sungei Gerong refinery near Palembang, and in 1941 was present when the refinery was destroyed by Dutch military forces in advance of the Japanese invasion.

During the last 5 years under Davidson's direction as manufacturing manager in New York, reconstruction of the important Sungei Gerong refinery has been accomplished and the company has extended its processing operations to include a newly built lubricating-oil plant in Australia and an interest in two refineries in Japan. Davidson only recently returned from Japan where he attended the opening of the Wakayama refinery.

Davidson, who comes from a midwestern oil family, entered Case Institute of Technology in 1915. After service in World War I as a second lieutenant in Italy, he was graduated from Case in 1921 with a degree in chemical engineering.

His first job in the oil industry was as a roughneck in northern Louisiana and Arkansas fields. In 1924, he went to work at the Baton Rouge refinery of Standard Oil Co. of Louisiana and in the next 4 years advanced to assistant to the general superintendent.

In 1928, the Jersey Standard organization transferred him to its Far East company, Nederlandsche Koloniale Petroleum Mij., and the following year he went to Palembang, later becoming plant general manager there. During his entire 22 years' service with the company, the refinery has undergone a twelve-fold expansion from about 5,000 to more than 60,000 bbl. daily.

Davidson was transferred back to New York in 1940 but was in the East Indies on a trip 4 months before Pearl Harbor in 1941. After the destruction of the refinery, he escaped overland to the West Coast of Sumatra and on to Australia. He became a major in the Army and served in the Southwest Pacific until 1943 when he was transferred to Washington to the petroleum section of the Corp of Engineers.

Rejoining the company in 1945, he became manager of all its manufacturing operations with headquarters in New York.

P. W. Fairchild has been transferred from Shell Oil Co.'s Houston office to the Kansas exploration division as subsurface geologist. Other changes include: **N. H. Potts,** subsurface geologist at Wichita Falls, transferred to the Oklahoma City division; and **G. H. Thompson, Jr.,** subsurface geologist at the Kansas division, transferred to the Denver district.

John C. Savaso, formerly engineering clerk with Fish Construction Co., at Opelousas, La., has joined Texas Illinois Natural Gas Pipeline Co., at Wharton, Tex., as civil engineer.

G. W. MURPHY

George W. Murphy, junior petroleum engineer in the Central district at Oklahoma City for British-American Oil Producing Co., has been transferred as petroleum engineer to the southern district, located at Houston, replacing **R. P. Dunkerly.** Murphy an Oklahoma A. & M. College graduate, joined British-American in November 1948, since which time he has been doing engineering work in Wyoming and the Oklahoma area.

Dr. John R. Sandidge, of Magnolia Petroleum Co., has been elected president of the South Texas Geological Society for the term of January 1, 1951, to December 31, 1951. Other officers elected include: **James K. Rogers,** Arkansas Fuel Oil Co., vice president; **Roland F. Hodder,** Stanolind Oil & Gas Co., secretary; **Charles M. McDaniel, Jr.,** Atlantic Refining Co., treasurer; and **Robert G. Kurtz,** Ohio Oil Co., executive committee.

R. J. Harwood has been elected president of the Kansas Independent Oil and Gas Association. Other officers elected include: **Pierce Musgrove,** vice president; **Jack Heathman,** vice president; **Lester Wilkonson,** secretary; and **William S. Brunson,** treasurer. **E. B. Shawver** is a lifetime vice president.

Glen F. Bish, division manager of the Tulsa area for Ohio Oil Co., has returned to Tulsa from a tour of study at the Harvard School of Business Administration. **William B. Berwald,** assistant chief engineer of the company, who replaced Bish during his absence, has returned to Findlay, Ohio.

Dr. T. W. Evans, research director of Shell Development Co.'s Emeryville, Calif., laboratories, has been elected vice president of the firm. He joined the staff at Emeryville as research chemist in 1930, after receiving the Ph.D. degree from University of Washington. In 1934 he went to Shell Chemical Corp.'s alcohol plant at Martinez, Calif., and was assistant superintendent during the plant's initial operations. He returned to Emeryville in 1936, became an associate director of research in 1942, was named manager in 1947, and director of research in 1949.

L. R. Drevescraft, Amerada Petroleum Corp., has been named district geologist for Wyoming, Colorado, Nebraska, and South Dakota, with headquarters at Casper, Wyo., replacing **C. S. Agey** who has been transferred to Tulsa as assistant chief geologist. **M. W. Goering** has been named district geologist for Montana and North Dakota with headquarters in Billings, Mont.

E. A. Smith, associated with Canadian Oil Cos., Ltd., of Petrolia, Ont., since 1919, and since 1936 superintendent of the Petrolia refinery, has been appointed manager of manufacturing for the firm. **V. M. Norwood,** plant superintendent since 1943, succeeds as general superintendent.

H. I. Wolff, formerly chief technologist at Shell Chemical Co.'s Houston plant, has been named section leader in the firm's home office at San Francisco. He is being replaced at Houston by **Irving I. Shultz,** formerly of the home office. **W. F. Commungs** and **D. N. Rindsberg,** both of the Houston plant, have been named acting assistant department managers.

PERSONALS

E. M. Pincomb, geophysical party chief for The Texas Co., has been transferred from Longview to Greenville, Tex., in the same capacity.

A. A. STAMBAUGH

Armstrong A. Stambaugh, senior vice president of Standard Oil Co. (Ohio), has been elected chairman of the board. His principal responsibilities will be the conduct of the company's public and industry relations, the coordination of internal and external relations, the coordination of internal and external communications, and consultation on general sales policies. He has been with the firm continuously since 1928. **Samuel H. Elliot,** vice president, director, and general sales manager of Sohio, has been named vice president in charge of sales. Joining the firm in 1929, he was active in business research, assisting in the development of nonpetroleum merchandising from 1931-34, and was named a director in 1949. **Alfred E. Wolf,** vice president in charge of finance and secretary of the firm, now becomes a member of the board of directors. He was named assistant to the president in 1941, and vice president in charge of finance in 1948.

A. E. WOLF

S. H. ELLIOT

M. A. Wilson, of Bartlesville, Okla., has been elected comptroller of Cities Service Oil Co. (Del.), Cities Service Pipe Line Co., and other Bartlesville affiliated companies. He will also continue as assistant secretary of these companies.

C. H. Mims, United Geophysical Co. party chief, has been transferred to the Middle East area to head a new seismic party.

J. L. Burke, Tulsa, president of Service Pipe Line Co., has been elected chairman for 1951 of the Committee for Pipe Line Cos. during the committee's annual meeting in Chicago. He succeeds **William C. Kinsolving,** Philadelphia, president of Sun Pipe Line Co. **Ralph B. McLaughlin,** Houston, president of Texas Pipe Line Co., was elected vice chairman, succeeding Burke.

Charles C. Loveless, Jr., assistant to the president of The California Co. at New Orleans, has been chosen a member of the executive committee of the New Mexico Oil and Gas Association, succeeding **A. R. McQuiddy** who has resigned.

William Gill, formerly chief geologist with Danciger Oil & Refining Co., has been appointed chief geologist of Southern Production Co., Inc. The latter firm recently acquired Danciger.

O. O. McKenzie, district superintendent for Service Pipe Line Co. at Galesburg, Ill., has been named Nebraska division manager succeeding **W. S. Partner,** Scottsbluff, Neb., who has retired. McKenzie, who joined the firm in 1925, will become one of the company's eight division managers.

L. H. Kindig has been elected assistant treasurer for Cities Service Oil Co. (Del.) and Cities Service Pipe Line Co. He has been with the firm for 26 years.

W. R. Wight, independent operator, has moved his offices from Fort Worth to Beaumont, Tex.

O. S. Trigg, Jr., engineer for Texas Gas Transmission Corp., has been transferred from Memphis, Tenn., to Owensboro, Ky.

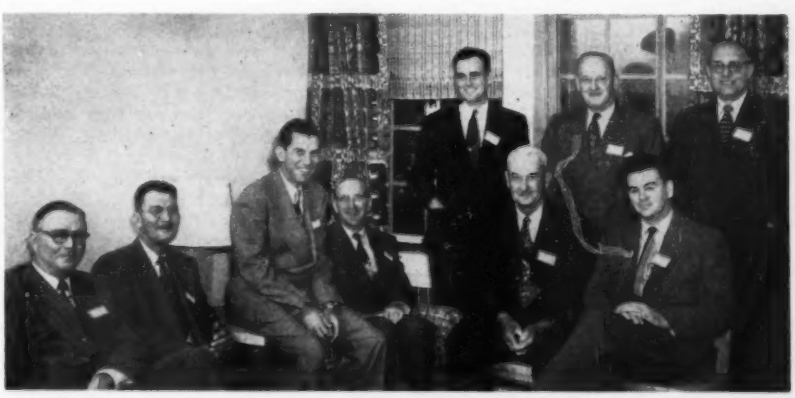
W. L. McCann, petroleum engineer for Stanolind Oil & Gas Co. at Tulsa, has been transferred to Shreveport, La., as district engineer.

C. G. Tuttle has been transferred from Cities Service Gas Co.'s Wichita compressor station to the Petrolia, Kans., compressor station as superintendent, and **M. J. Weckerling** has been transferred from the Petrolia station to the Tallant, Okla., compressor station as superintendent.

L. W. STORMS, JR.

Louis W. Storms, Jr., formerly with Creole Petroleum Corp., has been elected president of Pantepec Oil Co., C. A., and its affiliate, Pancoastal Oil Co., C. A. Storms, a petroleum engineer and production specialist, was associated with Creole for 5 years and before that with other affiliates of Standard Oil Co. (N. J.) for 18 years. His headquarters will be in Caracas, Venezuela. Storms succeeds **Florent H. Bailly,** who is retiring to devote his time to the management of International Petroleum Consultants, Ltd., Pasadena, Calif., of which he is president. He will also serve Pantepec in a consulting capacity.

W. F. Bowser, geologist and land man for Rine Drilling Co., has resigned to enter independent consulting practice. He was previously chief



EXECUTIVE COMMITTEE.—Above are members of the New Mexico Oil and Gas Association's executive committee, who were reelected at the twenty-second annual meeting in Santa Fe recently. Seated: D. D. Bodie, Cities Service Oil Co., Hobbs; Ralph L. Hendrickson, Stanolind Oil & Gas Co., Hobbs; Joe W. Lackey, Malco Refineries, Inc., Roswell; W. B. Macey, American Republics Corp., Artesia; Emery Carper, Carper Drilling Co., Artesia, president; John M. Kelly, Roswell, treasurer. Standing: Emmett D. White, Leonard Oil Co., Roswell; J. N. Dunlavey, Skelly Oil Co., Hobbs; Dudley Cornell, Albuquerque. Unable to attend were: Van S. Welch, vice president, Flynn, Welch & Yates, Artesia; and F. J. Danglade, Lovington.

PERSONALS

geologist for Sunray Oil Corp., and has served as Kansas-Oklahoma district manager for Lion Oil Co.

Herbert E. Schnur has been named assistant comptroller for The Texas Co. with headquarters in Houston.

F. B. PLANK

F. B. Plank, Bartlesville, Okla., has been elected a director, vice president, and secretary of Cities Service Oil Co. (Del.) and Cities Service Pipe Line Co., succeeding **C. E. Murray,** who will retire. A graduate of Purdue University, Plank joined Cities Service in 1918 at Bartlesville, and from 1928 to the present date has devoted most of his time to tax matters and has served as tax adviser to Cities Service Gas Co. and Arkansas Natural Gas Corp.

A. M. Knouse, party chief for The Texas Co. at Corpus Christi, Tex., has been transferred to Sterling, Colo., in the same capacity.

Clyde M. Ihrig, district foreman for Interstate Oil Pipe Line Co., has been transferred from Kinta to Wilson, Okla.

R. H. Beckwith, district geologist for Union Oil Co. of California, has been transferred from Laramie, Wyo., to Roswell, N. M.

G. M. Andreen, petroleum engineer for Magnolia Petroleum Co.'s Vanderbilt, Tex., producing district, has been transferred to the firm's general offices in Dallas. **Glen W. Barb,** petroleum engineer for the Louisiana-Gulf district located at Morgan City, La., has been transferred to the Vanderbilt district in the same capacity.

R. P. Dunkerly, formerly Gulf Coast district engineer for British American Oil Co., Ltd., has joined Housh Drilling Co., Houston, in an engineering capacity.

Ralph W. Ruwwe, of Stanolind Oil & Gas Co. at Wichita, was elected president of the Kansas Geological Society for 1951, succeeding **Frank Brooks** of El Dorado Refining Co. Other new officers include: **Gerald Kathol,** of the consulting firm of Tomlinson & Kathol, vice president: **Richard A. Shelly,** Bay Petroleum Corp., secretary-treasurer, and **W. G. Iverson,** Continental Oil Co., member of the board of directors.

Rex E. Richardson, formerly with Cities Service Gas Co., has joined Michigan-Wisconsin Pipe Line Co. at Sterling, Kans., as station superintendent.

Edward L. Taylor, chief production clerk in the Tulsa office of British-American Oil Producing Co., has been appointed contracts superintendent to coordinate the various phases of the liquefied-petroleum and natural-gas business for the company. **Joseph C. Pulliam** has been named to succeed Taylor as chief production clerk.

V. L. Culbertson, junior geologist for Shell Oil Co. at New Orleans, has been transferred to Jackson, Miss., as surface geologist. Other changes in the firm include: **R. R. Barr,** drilling foreman, transferred from Midland, Tex., to Franklin, La.; **J. D. Boswell,** mechanical engineer, transferred from the Tulsa area to Lake Charles, La.; **P. J. Doody,** junior mechanical engineer, transferred from New Orleans to Franklin; **L. M. Gutierrez,** engineer's assistant, transferred from the New Orleans production department to the exploration department as seismologist assistant; **R. G. Hileman,** junior exploitation engineer, from New Orleans to Lake Charles, La., as exploitation engineer; **D. J. Wilson,** drilling foreman, from Franklin to Lake Charles; and **R. C. Loring** and **J. E. Walker,** both formerly of the New Orleans exploration department, have been transferred to Calgary, Alberta, Canada, on temporary assignments.

Charles Hissom, tool pusher for Hissom Drilling Co., has been transferred from Harlem, Mont., to Odessa, Tex., in the same capacity.

J. H. Gardner has joined Shell Oil Co.'s Houston refinery as technologist.

Loring E. Heckman has been appointed chief of the Division of Gas Certificates by the Federal Power Commission, succeeding **James V. O'Connor** who resigned to enter private practice. Prior to joining FPC in 1945, Heckman was division chief in the Natural Gas Section of the Petroleum Administration for War, and before entering federal service in 1942 was associated with United Fuel Gas Co. of Charleston, W. Va.

DEATHS

Henry Harold Wheatley, 57, for the past 13 years deputy to the managing director of Iraq Petroleum Co., Ltd., died in London December 10 shortly after returning from an inspection tour of Iraq and the Middle East. A leader in the I.P.C. group of companies, Wheatley had joined the firm in 1938 following many years of service to the Iraq Government, during which time he resided in Baghdad. He was credited by I.P.C. with having carried a great part of the load of managing the group during World War II.

Stanley M. McDonald, 35, assistant general manager of Louisiana Land & Exploration Co., died in Midland, Tex., on December 11.

Guy L. Waggoner, 67, member of the Texas oil and ranching family which established the Three-D oil empire, died December 12, at Vernon, Tex.

G. A. Daeuble, Jr., 60, vice president of Henry Vogt Machine Co., and manager of valve and fitting sales, died November 26 in Louisville.

G. B. Watson, 89, retired oil-company official, died December 13 in Tulsa. He was superintendent for Oklahoma State Oil Co. in the early 1900's, and later superintendent for Texolan Oil Co. in Tulsa.

William Gilbert Fortner, 58, oil producer, died in Princeton, Ind., on December 11.

Ralph Talley, 62, superintendent of the land department of Magnolia Petroleum Co. since 1923, died December 12 in Dallas.

John Lafayette Price, 34, rotary drill helper for Richardson & Bass, died December 10 at Pointe a la Hache, La.

W. P. Faulkner, 67, owner and president of Faulkner Petroleum Co. of Wichita, died in Wichita December 17.

Arthur E. Hinch, 87, retired comptroller of Standard Oil Co. of New Jersey, died December 12 at Montclair, N. J.

Raymond Casper Rochelle, 61, manager of Leland Fikes Oil Corp., died December 12 in Dallas.

A. V. Warner, 70, division manager for Pierce Oil Co., and later an independent operator, died recently at Greenville, Tex.

WORLD-WIDE OIL REPORT

1950-1951 ANNUAL INTERNATIONAL NUMBER

OIL ABROAD.—Sometime ago outlook generally discouraging... Future prospects now more optimistic, statistically... Petroleum industry plans for increasing world producibility, expansion of refining, and transportation facilities indicate that sufficient supplies will be available generally to meet the expected large demand for the next 3 years... Margin is about 10 per cent over demand.

EXPLORATION ACTIVITY.—Three examples illustrate impressive efforts in world-wide operations to add reserves to proven list... These are Creole Petroleum Corp., on Guanoco concession in eastern Venezuela... Petroleos Mexicanos and Mexican American Independent Co. in Mexico... the new Manabi Exploration Co., Inc., on concessions totaling 1,563,696 acres, in Ecuador.

DRILLING ON INCREASE.—Rotary rigs now running in South America total 216 vs. 204 a year ago... In Europe, now 75 against 54 previously... African oil countries now 21 vs. former 19... Middle East has 35 against 41 before... North America, exclusive of the United States, has 45 compared with 40... Grand total currently, 453 compared with 413 in November 1949.

CRUDE-OIL PRODUCTION.—Output of crude on world-wide basis this year will average 10,377,000 bbl. daily... This is a jump of 11.5 per cent over previous year... Total crude production outside United States this year, and including estimated output of Russia and Communist eastern Europe, will run 4,974,000 bbl. daily... This represents an increase of 16.7 per cent over 1949.

PIPE-LINE CONSTRUCTION HEALTHY.—Countries having important foreign crude-oil pipe lines planned or under way include Iraq, Italy, Argentina, Iran, Mexico, Venezuela, Canada... Significant foreign products-pipe-line projects are found in Colombia, Brazil, Canada, Mexico, and Sweden... Natural-gas pipe-line projects planned and under way abroad are in Italy, Argentina, Canada, Mexico, and Venezuela.

REFINING CAPACITY GROWS.—Charging capacity, crude-oil basis, now 10,590,-285 bbl. for world, exclusive of U.S.S.R. and satellites... Daily cracking capacity, same basis, now 4,929,885 bbl.... Operating refineries for world except U.S.S.R. and satellites number 604 separate individual units... Iran has 1 unit with 500,000-bbl. crude capacity... West Indies has 9 refineries totaling 724,300 bbl.... France totals 16 refineries with 363,100 bbl.... Canada has 29 refineries with 339,700 bbl.

The Oil and Gas Journal

WORLD-WIDE OIL REPORT

In this 25-page section is presented the latest information on current activities and operations for all divisions of the industry, country by country. Material for the section was obtained by cable, telephone, and air mail from abroad, and was consolidated and assembled by Dahl M. Duff, International Editor, at the Journal's New York office. Important background information is included, to the end that the section is a veritable 1950-51 Guide Book to International Oil.

THE MIDDLE EAST—A REGION OF SUPERLATIVES

Iran . Iraq . Saudi Arabia . Kuwait . . . And African Oil Countries

AS is known to oil men, the Middle East comprises the area in and adjacent to the great basin occupied by the Tigris and Euphrates rivers and the Persian Gulf. It covers portions of Iran, Iraq, and Saudi Arabia as well as Kuwait, Bahrein, Qatar, and smaller shiekhdoms to the south. The term also is used to describe the region to the northwest in Syria, Lebanon, Israel, Transjordan, and Turkey.

Though poorly located geographically, the Middle East with its enormous reserves has become the main source of oil for practically all of the non-communist Eastern Hemisphere. American oil men who visit the area for the first time continually come away amazed at the magnitude of the operations being carried on. The Middle East has become a region of superlatives for the oil industry. Among other things, it has the world's largest refinery, the greatest producing field, and largest long-distance crude-oil pipe line.

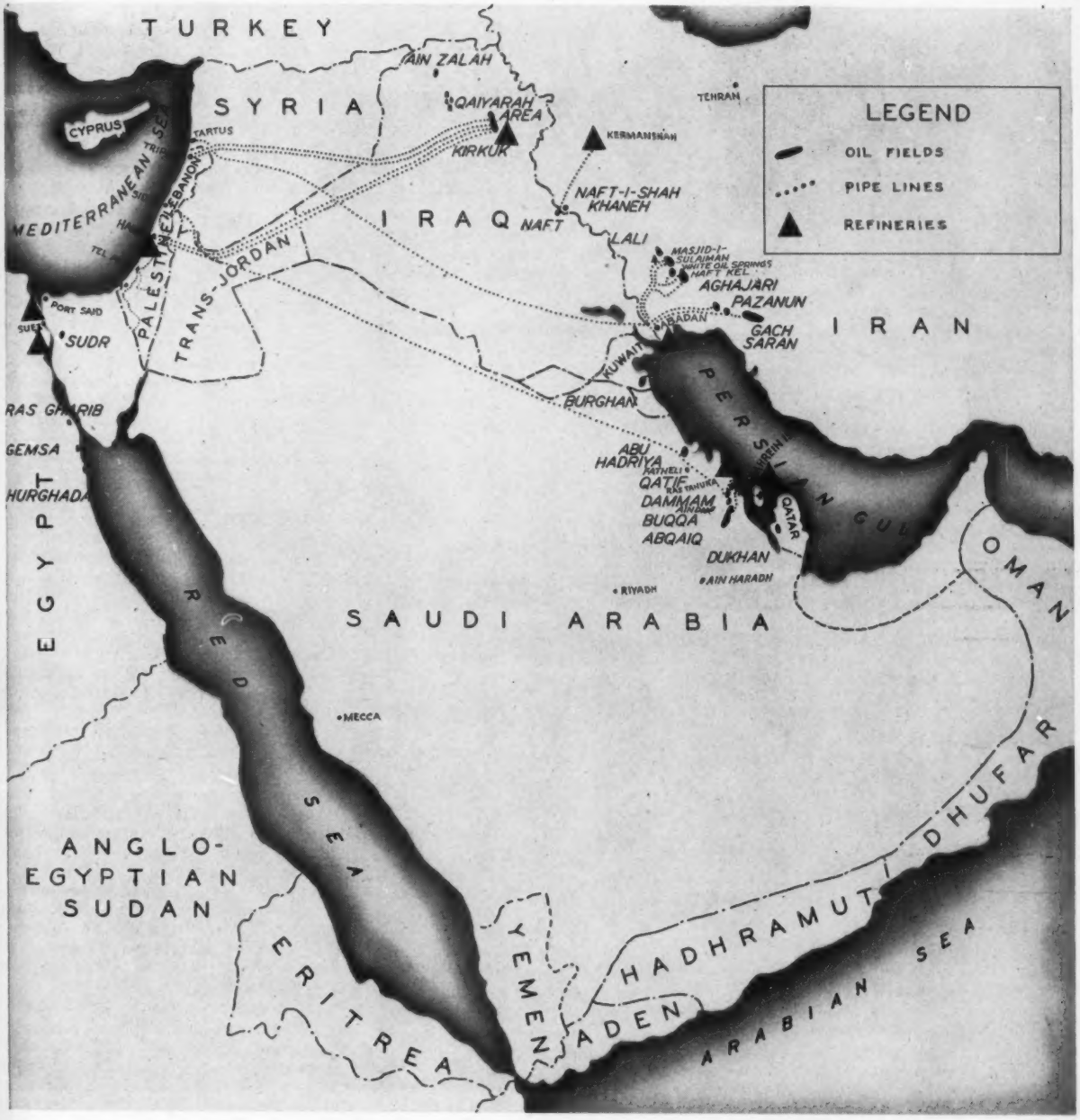
Oil was first discovered in the Middle East at Masjid-i-Sulaiman field in western Iran in 1908 on a concession which had been granted to the Englishman, William Knox D'Arcy, 7 years earlier by the Persian Government. In 1913, the British Government acquired an interest in the then Anglo-Persian Oil Co., Ltd. This interest has since been increased to about 56 per cent. It was one of the world's first governments-in-oil arrangements, and was made at a time when the British Navy was converting to oil fuel.

Up until 1927, Iran was the only producing country in the Middle East. Then came the discovery of Kirkuk field in Iraq and the completion 7 years later of the dual pipe-line system from Kirkuk to the Mediterranean. The wholly American companies entered the Persian Gulf region in the early 30's, discovering oil in Bahrein in 1932. Oil was discovered in Saudi Arabia in 1938, though some noncommercial quantities were found in 1935. Kuwait's oil was discovered in 1938, that in Qatar, 2 years later.

The tremendous importance of the Middle East to the world oil economy began to be fully appreciated in the late 1930's. Through the first quarter of the century, Anglo-Iranian steadily increased its output in Iran, raising it to about 3.3 per cent of the world total when Kirkuk was discovered in 1927. Middle East oil was used to the maximum possible extent during the war. By 1945, its total production made up nearly 7 per cent of the world's total. Currently it is about 18 per cent of the world's total.

There are five different operating organizations involved in production in the Middle East. These represent nine oil companies. Though the interests of these owning companies are separate, the pattern is somewhat confusing since most of the companies have holdings in more than one area. In addition to these companies, Pacific Western Oil Corp. and American Independent Oil Co., the latter representing nine United States independents, is exploring the Saudi Arabian-Kuwait Neutral Zone.

Anglo-Iranian operates the only concession in Iran. It and Gulf Oil Corp. share ownership of Kuwait Oil Co., Ltd., operating in Kuwait. Anglo-Iranian, Cie. Francaise des Petroles, Shell, and Standard Oil Co. (N. J.), and Socony-Vacuum Oil Co., Inc., together, each hold equal interest in Iraq Petroleum Co., Ltd., and its associated companies, less the 5 per cent interest of C. S. Gulbenkian. I.P.C. controls the production in Iraq and Qatar and has exploratory concessions in various other Middle East areas. Standard Oil Co. of California and The Texas Co. jointly own Bahrein Oil Co., Ltd., operating in Bahrein. California Standard, Texaco, and Jersey Standard each hold 30 per cent, and Socony-Vacuum 10 per cent, in both Arabian American Oil



Co. and Trans-Arabian Pipe Line Co.

There have been many unofficial estimates of oil reserves of the Middle East. The companies, whose figures are confidential, have the best information but in many cases fields have not been fully defined and evaluated. During the war, E. DeGolyer estimated Middle East reserves at 32 billion barrels. It now appears that this total is considerably low. Some estimates credit the Persian Gulf region with half the world's total. In any case, the question of actually numerically valuing Middle East reserves is somewhat academic since the oil available is sufficient for all foreseeable needs and the limitation is one of transportation and refining capacity, not producing potential.

Production operations in the Middle East are characterized by highly advanced reservoir-engineering techniques. This is made possible by the single-company operation not only of fields but of entire areas. Pumping wells are unknown in the Middle East. Observation wells are used to study the level of reservoir fluids, and many wells produce 10,000 bbl. or more daily. Exploration work is being carried out in various areas, including offshore in the Persian Gulf, a deep testing is under way in Bahrein and Kuwait.

Four refineries are located in the Middle East. Total capacity is well over three-quarters of a million barrels. The largest, and the world's largest, is the Abadan refinery of Anglo-Iranian Oil Co., Ltd., with a throughput capacity of 500,000 bbl. daily. Other large refineries are at Ras Tanura in Saudi Arabia and on Bahrein Island. A 25,000-bbl. daily plant, mainly for bunker production, was completed in 1949 by Kuwait Oil Co., Ltd.

Production of these refineries in the future is expected primarily to meet requirements in the future in Asia and Africa, rather than in Europe. The great expansion in Europe's own refining capacity shows that this

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area will import more and more crude and less products. The Middle East's crude production also is regarded as a marginal and supplementary source for the United States and Canada.

Of great economic significance in connection with Middle East oil was the recent opening of the trans-Arabian crude line from Saudi Arabia to Sidon, Lebanon. This is the first of three such big-inch lines being built from producing areas to the Mediterranean. Ultimately they will mean cheaper transportation for the crude oil than the 3,200-mile tanker haul around the Arabian Peninsula and through the Suez Canal with its approximately 18-cent toll. The construction of the Trans-Arabian line half way around the world from supply sources and in a completely undeveloped area was an engineering and logistics achievement comparable to the construction of the Panama Canal.

Several billion dollars have been poured into the expansion of facilities in the Persian Gulf since the end of the war. A large part of this expenditure—some estimate as much as half — goes into auxiliary programs and projects not strictly connected with the oil business itself. Large sums are spent on hospitals, schools, housing, and other developments. Much assistance, financial and otherwise, is given to the Middle East governments, most of which are attempting to improve and broaden the economy of their countries.

What has been accomplished in the Middle East since the end of the war has been in spite of serious problems and handicaps. The Jewish-Arab war caused the closing of the Haifa refinery and the line from Kirkuk. Shipment of steel from the United States to the Middle East has frequently been attacked in the United States. The pricing system for the production has been under fire, and the region has been called "militarily indefensible."

Nevertheless, the companies concerned have contributed toward the over-all goal of providing an oil supply for the Eastern Hemisphere. Despite the interlocking ownership, there is keen competition among the operators, particularly for the major markets of Europe, and barring a general war, the Middle East will occupy a dominant oil position for many years to come.

IRAN

Production, bbl. daily	**700,000**	**Population**	**17,000,000**
Production, accum., bbl.	**3,122,000,000**	**Area, sq. miles**	**628,000**
Reserves, bbl.	**12,000,000,000**	**Currency**	**Rial**
Refining cap., bbl. daily	**500,000**	**Value**	**3.1 cents**

WITH a production which this year has been at or near the 700,000-bbl. daily mark, Anglo-Iranian Oil Co., Ltd., now ranks as the world's No. 1 producing company. Its producing area consists of a string of seven fields to the east and north of the head of the Persian Gulf. Besides these main fields, the company operates the smaller Naft-i-Shah field on the Iraq border about 300 miles north of the Persian Gulf.

These seven fields produce from the Asmari limestone at depths ranging from 2,000 to 9,000 ft. Greatest production is being obtained from Agha Jari field, and next from Haft Kel. The average thickness of the pay section in these fields varies from 600 up to 1,500 ft.

All seven of the fields are connected by pipe line to the Anglo-Iranian refinery at Abadan or to an export terminal at Bandar Mashur. The total length of this pipe-line system is more than 1,000 miles. Individual lines range in size up to the 20-22-in. which was completed last year to provide additional capacity from Agha Jari to Bandar Mashur.

The refinery which Anglo-Iranian operates at Abadan is from the standpoint of capacity the world's largest. A 29,000-bbl.-daily fluid catalytic cracking unit and associated gas-recovery plant has recently been built. Another new addition to the process section is a small lubricating-oil plant to serve the needs of the local Middle East market.

The history of Anglo-Iranian's operations in Iran is an illustration of the effort and expenditure that must be made in connection with oil discovery and its large-scale development in the more remote and undeveloped regions of the world. William K. D'Arcy, an Englishman who had made a fortune in Australia, became interested in oil in Iran prior to 1900, after reading a memorandum by a French geologist and archaeologist.

D'Arcy negotiated a concession with the Iranian Government May 28, 1901. Despite the difficulties of primitive transportation, drilling began near the present Naft-i-Shah field in December 1902. The well was abandoned when the oil found was too small in quantity to justify a line to the seacoast. D'Arcy then obtained additional financial assistance and drilled another well near the present Haft-Kel field. This also was unsuccessful. The third well was at the site of the present Masjid-i-Sulaiman field. There, just as funds were on the point of exhaustion, oil was discovered in large quantities May 26, 1908, almost exactly 7 years after the grant of the original concession.

Anglo-Persian Oil Co., which was renamed Anglo-Iranian Oil Co. in 1935, was formed in 1909. A pipe line from the discovery field to the refinery site at Abadan was completed in June 1911. Its original capacity was about 8,000 bbl. daily. Work was begun on the Abadan refinery in 1909 and completed some 3 years later. At the time the refinery was constructed, the area consisted of a few scattered huts and palm groves.

Anglo-Iranian's expansion in the following years was affected by both World Wars I and II. Hostile forces menaced the refinery and fields after Turkey entered the war in 1914. During World War II, Anglo-Iranian production was stepped up considerably to meet military demands and those caused by the loss of Burma and Indonesia. The aviation-gasoline plant completed in 1940 at Abadan was greatly expanded to meet Allied requirements, including those of Russia.

In 1933, the original Anglo-Iranian concession agreement was revised to conform to new conditions. The concession area was limited to 100,000 sq. miles, and annual royalty, previously a percentage of net profits, was placed on a tonnage basis plus participation in the distributed profits on all the company's operations in Iran and elsewhere. On July 17 of last year, the company and the government reached agreement on a supplementary contract. This supplement, which has not yet been ratified by the Iranian Parliament, raises total payment to the government by 50 per cent to the equivalent of about 33 cents a barrel.

Anglo-Iranian carries out a large-scale welfare program in Iran. It has housing projects, canteens, clinics, clubs, and various types of schools. The company has supported the Iranian Government's policy of resisting

inflation by making foodstuffs and other commodities available to its employes at stable prices. In education, the company assists the work of the Iranian Government, especially in the Province of Khuzistan, and in addition, provides for training of selected Iranians in the United Kingdom.

Anglo-Iranian's operations in southwestern Iran provide the only oil produced in the country. The Russians have long sought concession rights in northern Iran, but sentiment in Iran appears to be against new concessions to any foreign group. The Iranian Government has embarked on a 7-year development plan to be financed from its royalty revenue from Anglo-Iranian. An Iranian Government Oil Co., provided for by law under this plan, came into being late in 1949. It laid out a program dividing the work into two phases of exploration and drilling and setting up eight regions in the country with priorities for operations. A Swiss geologist, Arnold Heim, was engaged as adviser to the company.

IRAQ

Production, bbl. daily	**135,000**	**Population**	**4,795,000**
Production, accum., bbl.	**440,150,000**	**Area, sq. miles**	**175,000**
Reserves, bbl.	**8,250,000,000**	**Currency**	**Dinar**
Refining cap., bbl. daily	**9,500**	**Value**	**$2.78**

NEXT to Anglo-Iranian, Iraq Petroleum Co., Ltd., has the longest record of operations in the Middle East. This truly international company has an unusually interesting history. It grew out of the reorganization of the old Turkish Petroleum Co. in 1928 following prolonged international negotiations.

American, British, Dutch, and French companies were given 95 per cent of the stock with the remaining 5 per cent held by C. S. Gulbenkian, an Armenian, now a British citizen, who had figured in the original Turkish Petroleum Co. negotiations. The American share of 23.75 per cent was first held by five companies but later three of these sold their interests to Standard Oil Co. (N. J.) and Socony-Vacuum Oil Co., Inc., who now participate equally through Near East Development Co. The other 23.75 per cent interest holders are Shell, Anglo-Iranian, and Cie. Francaise des Petroles.

A disagreement which arose after the World War II was based on the 1928 agreement of the I.P.C. partners only to participate jointly in most of the remainder of the Middle East. Actions were brought in British courts in 1948 when Jersey Standard and Socony-Vacuum arranged to buy an interest in Arabian American Oil Co. There was a question as to whether the so-called Red Line agreement of 1928 was still binding. Later in 1948 the matter was settled amicably with a new agreement changing the method of disposing of the production among the partners and providing for an expansion of output.

The concession which the Iraq Government granted I.P.C. in 1925 amounted to a revival of one granted by the Ottoman Empire to British and German interests before World War I. This covers the districts of Mosul and Baghdad east of the Tigris River. Oil was discovered in Kirkuk in October 1927.

Mosul Petroleum Co., Ltd., a part of the I.P.C. group, holds a concession covering the area west of the Tigris north of Lat. 33°. This was granted originally in 1932 to British Oil Development Co., which was taken over later by the present owners. In the district of Basrah in southern Iraq, Basrah Petroleum Co., Ltd., also I.P.C. associated, hold the concession. In addition to the operations of the I.P.C. organization, Khanaqin Oil Co. (owned by Anglo-Iranian) produces 8,000-8,500 bbl. daily in Naft Khaneh field in eastern Iraq. A pipe line extends to a company-owned refinery at Khanaqin.

Besides its Iraq concessions, I.P.C. through various associated companies hold exploration and production rights in a number of other areas of the Middle East, including Syria, Lebanon, Transjordan, and the Trucial Coast. Its only other production is from the Persian Gulf Shiekhdom of Qatar. Here oil was discovered prior to the war. After several years of development, commercial production at about 25,000 bbl. daily was begun in January 1950.

Kirkuk field in Iraq is a large and prolific reservoir. Wells are less than 3,500 ft. in depth and gravity of the oil is 36°. Low-gravity oil has been found in several fields to the northwest in the Mosul company's concession, but these are not commercially produced except for minor local consumption. In 1948, Basrah Petroleum Co. made Cretaceous discoveries of considerable importance at Zubair and Nahr Umr, west of the city of Basrah. These areas are now being developed for commercial production through a planned pipe-line outlet extending to the Persian Gulf.

I.P.C. since 1934 has had a pipe-line outlet from Kirkuk to the Mediterranean. By 1931, adequate reserves had been proved in Kirkuk to justify its construction. This original 12-in. system divides at the Euphrates River with one branch leading to Tripoli and one to Haifa. Together they were the first all-welded pipe lines to be built outside the United States. Each line had a capacity of 42,000 bbl. daily.

After the war, the company began looping these lines with 16-in. to provide additional capacity. All but 40 miles of the line to Haifa was completed when unrest following withdrawal of the British from Palestine prevented further work. Subsequently, the Iraqi Government refused to allow further movement of oil through this part of the old 12-in. system, thus causing a shutdown of the refinery operated in Haifa by Anglo-Iranian and owned jointly with Shell. Work on the other 16-in. loop to Tripoli was brought to completion in July 1949. All Iraq's present production of about 135,000 bbl. daily, except for Naft Khaneh, now goes to Tripoli.

A large expansion in Iraq production is scheduled with the completion of a new 30-32-in. line now being built. First pipe for this project was shipped from the United States early this fall. Its route parallels that of the 12 and 16-in. to Tripoli as far as Homs, Syria, where the new line will branch off to a new terminal at Banias, Syria. Completion is expected the latter part of 1952.

Like other companies in the Middle East, I.P.C. engages in a major program of welfare activities not directly related to oil operations. After lengthy negotiations, the company and the government reached an agreement this summer providing for an increase of 50 per cent in royalty payment to about 33 cents a barrel.

SAUDI ARABIA

Production, bbl. daily	**550,000**	**Population**	**6,000,000**
Production, accum., bbl.	**607,600,000**	**Area, sq. miles**	**350,000**
Reserves, bbl.	**9,000,000,000**	**Currency**	**Rial**
Refining cap., bbl. daily	**140,000**	**Value**	**24 cents**

THE original concession in the kingdom of Saudi Arabia was granted to Standard Oil Co. of California May 29, 1933, and augmented in May 1939. Exploration was commenced in September 1933 and test drilling in 1934. Results, however, were discouraging until commercial production was found in Dammam field in 1938.

The concession is now assigned to and held by Arabian American Oil

Co. Up until about 3 years ago, this company was owned equally by California Standard and The Texas Co. At that time, Standard Oil Co. (N.J.) and Socony-Vacuum Oil Co., Inc., took a 30 and 10 per cent interest respectively, and the acquisition was completed in December 1948 after restrictions against other Persian Gulf interests which were imposed on Jersey and Socony by the Iraq Petroleum Co., Ltd., Red Line agreement were modified.

Saudi Arabia's present production comes from three fields located near the Persian Gulf in the east central part of the kingdom. They are interconnected by pipe line to the Ras Tanura refinery and shipping point and by a submarine line to the Bahrein refinery which is operated by Bahrein Petroleum Co., Ltd., owned by two of the Aramco partners, Texaco and California Standard. The fields now have a western outlet into the new 30-31-in. Trans-Arabian pipe line to the Mediterranean.

The principal one of these producing fields is Abqaiq, located 30 miles southwest of Dhahran and Dammam field. Abqaiq now ranks as the world's largest producing field, surpassing East Texas field in the United States. Abqaiq's ouptut of some 450,000 bbl. daily at midyear was from only 45 wells. The field was discovered in 1941.

The other two producing fields are Dammam and Qatif. Aramco has four shut-in fields, some in the process of development. Abu Hadriya was discovered in 1940. To the west of Abqaiq is Ain Dar, discovered in 1948. Two other fields discovered last year are Fadhili and Haradh.

The refinery at Ras Tanura was built as a military project in 1943-45 with an estimated capacity of 50,000 bbl. daily. To meet demand for its production, the refinery has run more than 135,000 bbl. daily. Running the plant consistently at double or more of its rated capacity was made possible largely by augmenting pumping and charging equipment.

Aramco's activities outside its strictly petroleum-industry operations furnish a case study in the use of private capital in the development of a retarded area. The company has more than 20,000 employes, the majority of whom are Saudi Arabs. These Saudi Arab nationals have been completely trained in a variety of skills in the company's own program. Besides education, Aramco provides medical care, housing, and other benefits. It has assisted the the government in agricultural development, constructed a railroad, and engaged in a general sanitation and malaria-control program. The company's field headquarters are at its own town, Dhahran. Its American employes number approximately 4,500.

Construction of the trans-Arabian pipe line across 1,068 miles of mostly uninhabitated desert was completed early this fall after nearly 3 years of work. The line has a capacity to deliver 300,000 bbl. daily to the Mediterranean terminal at Sidon, Lebanon, where it will be loaded from offshore tanker berths. Of the entire line, 314 miles to Hafar al Batin in Saudi Arabia is classified as a part of Aramco's own gathering system. Approximately 5,000,000 bbl. are required to fill the system.

The large-scale program of construction of oil-connected facilities which was launched by Aramco shortly after the war has now been largely completed. Individual projects in this program included an Abqaiq generating plant of 20,000 kw., new machine shop at Abqaiq, the Dammam-Hofuf portion of the Saudi Arabian Government railroad, a large commissary in Dhahran, an automobile and truck repair garage at Abqaiq, a second loading wharf at Ras Tanura, and a 300,000-bbl. daily stabilization plant at Abqaiq along with a 100,000-bbl.-daily separator plant in the northern end of the field.

Late in 1949, the outlook for future production from Aramco's fields was clouded by world currency difficulties. As an American operation, Aramco's parents sold its oil for dollars in world markets. The dollar shortage and British Government restrictions against acquisition and use of sterling was the main factor in a sharp cutback in production and production schedules.

Subsequently, however, Aramco and certain of its parent-company "offtakers" were able to work out sterling agreements with the British. These arrangements and a general improvement in the currency situation have improved the position of Arabian oil. Now operating partially in nondollar currencies, including its royalty payments to the Saudi Arabian king, Aramco is required to obtain much of its personnel and purchase a substantial part of its equipment and other needs outside the United States.

KUWAIT

Production, bbl. daily	**350,000**	**Population**	**200,000**
Production, accum., bbl.	**226,100,000**	**Area, sq. miles**	**6,000**
Reserves, bbl.	**11,000,000,000**	**Currency**	**Rupee**
Refining cap., bbl. daily	**25,000**	**Value**	**21 cents**

THE development of Burghan field by Kuwait Oil Co., Ltd., (Anglo-Iranian and Gulf) since the war has been one of the most spectacular accomplishments in the industry. The field was discovered in February 1938 but the nine wells drilled prior to 1942 were plugged when the German drive in Egypt threatened this part of the world.

Drilling since the war has more fully revealed the enormous potentialities of this field. When work was resumed in 1945, completed wells were cleaned out, perforated, and placed on production. An orderly development program was undertaken. The history of the oil business has few instances of more rapid development of a major field. In 1948, production almost trebled the 1947 figure, and in 1949, it again was almost doubled. Recent output has been in excess of 350,000 bbl. daily.

Asphalt and other surface indications had long pointed to the oil possibilities at Burghan. A concession was granted in 1924 but lapsed. The present 75-year concession over the entire shiekhdom was granted December 23, 1934. The first well, drilled to 9,750 ft. in the Bahrah area north of Kuwait Bay, was dry. It was followed by the discovery well testing the Burghan high 28 miles south of the bay and 14 miles inland.

Burghan's reserves are a matter of speculation. Estimates range from 9 billion barrels upward, and the field is considered the largest single oil reservoir in the world. Production comes from a series of sandstones, unlike the limestone production found elsewhere in the Middle East. Most of the wells are dual producers. The proved area is in excess of 25,000 acres. The company has been drilling a deep test to determine the possibilities of production from the limestone which is believed to underlie the sand formations.

Along with its field development

work, Kuwait Oil after the war undertook a major program of construction of related facilities. Much of this has now been completed, and drilling and other work is now largely determined by market requirements. A 25,000-bbl.-daily skimming plant serving the local market and bunkering needs was finished last year. The new oil-loading jetty consists of a 4,100-ft. approach pier carrying eight 24-in. crude loading lines and a T-head providing 2,800 ft. for simultaneous loading of six tankers and a cargo pier about 1,050 ft. long for two cargo vessels.

Other projects in this program included facilities for a complete modern city in the Kuwait desert. One particular problem is a fresh-water supply. Kuwait has a rainfall of only about 4½ in. a year. Much fresh water is brought in by tanker, and the company has built low-pressure evaporating units. On a ridge 6 miles inland from the Persian Gulf the company has built a city for employes and their families. This includes housing, a 200-bed hospital, schools, laundry, bakery, electric-power plant, refrigeration plant, centralized air-conditioning, and recreational facilities.

A considerable part of the Gulf share of the production from Kuwait is purchased by the Shell organization under a long-term contract concluded in June 1947. The production is taken by Shell to satisfy its marketing requirements east of Suez.

A Mediterranean outlet for Kuwait crude will be provided when the projected Middle East Pipelines, Ltd., line is completed. Majority interest in this project is held by Anglo-Iranian. Several years ago there was discussion of the construction of another Kuwait-Mediterranean line by Gulf and Shell. This project was subsequently canceled.

EGYPT

Production, bbl. daily	**45,000**
Production, accum., bbl.	**133,800,000**
Reserves, bbl.	**185,000,000**
Refining cap., bbl. daily	**41,000**
Population	**19,090,000**
Area, sq. miles	**386,000**
Currency	**Egyptian pound**
Value	**$2.88**

THE political and legal situation has obscured the outlook in Egypt for nearly 3 years. The country's production has been nearly doubled since the end of the war, but further exploration has been arrested as a result of the government's failure to make certain legal changes. The present output ranging around 45,000 bbl. daily is considered to be about the maximum available from existing fields.

The two foreign companies operating in Egypt are Socony-Vacuum Oil Co., Inc., and Anglo-Egyptian Oilfields, Ltd. (Shell). These two companies operate jointly in the Sinai Peninsula. Standard Oil Co. of Egypt (Standard Oil Co. [N.J.]) withdrew from the country early last year in the face of the discouraging legal situation. An independent French and an independent Egyptian company took out a number of prospecting licenses this year.

Egypt's producing fields are in two groups. There are three to the west of the Gulf of Suez. Gemsa, discovered in 1908, is depleted. Hurghada, discovered in 1913, is largely on artificial lift with production amounting to about 750 bbl. daily. The third and most important field in Egypt is Ras Gharib. Though its production is also declining with the majority of the wells on artificial lift, the field's output still averages more than 21,000 bbl. daily. Water produced with crude in Ras Gharib is increasing, and Anglo-Egyptian, which operates all three of these fields, has expanded and improved its dehydration and desalting facilities.

The successful exploration in Egypt since the war has been to east of the Gulf of Suez on the Sinai Peninsula. Three new fields have been discovered as a result of the Anglo-Egyptian-Socony-Vacuum operations. These have been responsible for the net increase in Egypt's production since the war.

Sudr was discovered in 1946. Production is from 2,500-3,000 ft. Efforts to obtain deeper production were unsuccessful in a test drilled last year. Asl was discovered in 1948. Both these fields produce from basal Miocene sands and conglomerates and from Eocene limestone. Between these two fields and farther to the west is Ras Matarma which has not yet been placed on production. All these fields as well as Ras Gharib and Hurghada produce low-gravity crude.

Standard of Egypt spent an estimated $12,000,000 in exploratory work before suspending operations. Its action was taken shortly after the company had its first discovery early in 1949 at Wadi Feiran about 93 miles south of Suez. This discovery tested 25°-gravity oil from the Miocene at about 6,500 ft.

Egypt has two refineries, both of which are at Suez. Capacity of the Anglo-Egyptian plant last year was raised to about 38,000 bbl. daily. The second refinery is the Egyptian Government plant. Plans have been projected to expand capacity of this refinery to about 26,000 bbl. daily, and Lummus Co. has been given contract for the project.

The legal difficulties in Egypt arose principally out of the mining law which was passed in 1948. The foreign operating companies pointed out that certain of its provisions were completely unacceptable from their standpoint. One of these was the requirement that 51 per cent of the shares of any company holding a producing lease must be offered to Egyptians.

Negotiations between the companies and the government with a view to modifying the law have been prolonged and up to now unsuccessful. As a result the two remaining companies have halted all work outside existing leases and are confining their operations to field development and production.

Besides revision of the 1948 law, the companies are insisting that the government carry out the terms of the prospecting license under which Ras Matarma was discovered. This provided for a lease on the pre-1948 basis, but the government has not taken action on the lease application though it was filed in November 1948. The companies also are asking the government for a price for oil in Egypt in line with that in world markets and for assurances that the government will not penetrate into the sphere of private operations.

AFRICA

ALTHOUGH Egypt's fields supply the only production of general importance now obtained in Africa, there is considerable exploratory work taking place elsewhere in the continent. This has been particularly promoted by the French Government which is financing and encouraging exploration in France's extensive African territories concurrently with the program in metropolitan France itself.

In addition to the French program, British interests have been carrying out exploration in Britain's East African colonies, and in Ethiopia the Sinclair organization has drilled one well and is continuing geophysical work in preparation for further drilling on its concession in that country.

French exploration in Africa includes work in Tunisia, Algeria, French Morocco, French Equitorial Africa, Gabon, and Madagascar. After the war, the Monnet Plan's Fuel Modernization Commission was given

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the task of coordinating all oil exploration in the overseas territories as well as in metropolitan France. The French Bureau de Recherche du Petrole has a 9-year program for North Africa, calling for the use of 15 rigs, drilling over about 1,800,000 ft., and the study and testing of a total of 250,000 sq km. of territory.

Tunisia

In general, this program is being carried out through the medium of government-sponsored companies. The only non-French interests involved are in Tunisia. In this 48,313-sq. mile French protectorate, Gulf Oil Corp. and Shell are participating in separate French exploration companies.

Gulf holds 65 per cent interest in Soc. Nord Africaine des Petroles with the remaining shares vested in a Tunisian state-French Government company, SEREPT. Shell also has a 65 per cent controlling interest in Cie. des Petroles de Tunisie. The concession agreements were signed early this year after more than 2 years of negotiations. Gulf has a program of seismic and aerial magnetometer work to be followed by drilling probably late in 1951.

There are various surface indications of possible production in Tunisia, and the record of intermittent exploratory efforts dates back to 1910. The British Carthage Oil Syndicate drilled a number of shallow wells, one of which was considered productive. French interests encountered small shows near Cap Bon east of Tunis in 1926, and a number of tests were drilled both before and since the war by the SEREPT organization. Some of these obtained gas flows and indications of oil.

Algeria

Attempts to find oil in Algeria have been made since 1890, but systematic geological work has been undertaken only in the last 8 years. The work is now being carried out by Soc. des Petroles d'Aumale in which ownership is shared equally by S. N. REPAL (French and Algerian governments) and Soc. des Raffineries de Petrole d'Algerie, a private company. Production amounting to a few hundred barrels daily is being obtained in the Sidi Aissa area in northern Algeria. Two producing formations were discovered in this area in February 1949.

French officials have said they expect the area to be producing about 4,500 bbl. daily in about 3 years' time. In announcing its assistance in a $15,000,000 project to provide exploration and drilling equipment for the French program in both Algeria and Morocco, the ECA in Washington last May said surveys had shown that seven-ninths of Algeria's territory is "underlaid by potential oil-bearing strata."

Morocco

In Morocco, operations are in charge of Soc. Cherifienne des Petroles. This company was founded in 1929; capital is held by the French and the Moroccan governments except for 7 per cent by private interests. In late 1947, it discovered Oued Beth field where nearly 1,000 bbl. daily is being produced from fault blocks from 3,300-3,400 ft. There are three other small fields. Production is refined in a small topping plant located in the field.

Gabon; Madagascar

In Gabon, exploration was first carried out in 1930, and geophysical work was commenced after the war. Two rigs are now in operation. Soc. des Petroles de l'A.E.F., 60 per cent owned by the government, holds an exploration permit for all of French Equitorial Africa. On the island of Madagascar, Soc. des Petroles de Madagascar has been organized. The company has ordered equipment for a more intensive exploration program.

Ethiopia

Sinclair Petroleum Co.'s 1 Gumburo in southeastern Ethiopia went to more than 10,000 ft. before it was suspended last April. The company obtained valuable geological information from the well even though it was nonproductive. The test was the first ever drilled in the East African kingdom. Sinclair is continuing geophysical work on the more likely areas of its large concession in the country.

Somaliland

Preliminary exploration work is under way in the British protectorate of Nyasaland in East Africa. The Uganda Protectorate also is carrying out a drilling program.

Outside of Egypt and the small topping plants in Algeria and French Morocco, there are no refineries in Africa. The government of South Africa has long promoted a proposal for a plant to convert coal to liquid fuels, and there have been at least two projects for the construction of refineries. The government's interest is one of foreign-exchange savings. Union Petrol Refinery, Ltd., backed partly by British capital, has proposed a major refinery, and Standard-Vacuum Oil Co. has for several years studied construction of a plant in South Africa.

THE FAR EAST—STILL UNDERGOING REHABILITATION

Japan . Indonesia . Borneo

WAR and the threat of war exert a depressing influence on petroleum operations in many parts of the Far East. Little is being accomplished in Burma because of civil strife. China has fallen behind the iron curtain since conquest of that country by the Communists. Rehabilitation work is largely complete in Indonesia but some areas are still closed because of unsettled conditions in the new republic. Strained relations between India and Pakistan in the past have adversely affected petroleum operations in Assam.

Total production throughout the entire region of the Far East and southeast Asia amounts to approximately 235,000 bbl. daily. This contribution to the world's crude output is relatively small when compared with that of the United States, Latin America, or the Middle East. Nevertheless, the oil production in the Far East and southeast Asia plays an important part in the world petroleum trade because of its geographic and strategic location near approximately one-third the world's population.

In this part of the world, British interests in the aggregate outweigh those of the American companies. Two Royal Dutch-Shell subsidiaries handle the significant production in British Borneo, and other members of the Shell Group operate in Indonesia.

American companies represented in Indonesia are Standard-Vacuum Oil Co. (Standard Oil Co. [N. J.] and Socony-Vacuum Oil Co., Inc.) and the Caltex organization. Anglo-Iranian Oil Co., Ltd., participates in exploration in New Guinea. Burmah Oil Co., Ltd., operates in Burma, India, and Pakistan, and Attock Oil Co., Ltd., controls most of Pakistan's small production.

Japan's small but increasing output is 90 per cent controlled by Imperial Oil Co. which has been reorganized in the breakup of Japanese industrial trusts by occupation authorities. Efforts to find oil in Australia are being continued, the most prominent recent development being the spudding in of a well by Shell in Rolleston district of Queensland. This test culminates a 5-year program by Shell in Australia. The commonwealth and state governments are assisting in geological and geophysical work elsewhere in Australia.

Refining.—Refineries in the Far East are in general adapted to handle production from local field areas, but other plants operating on imported crude are found in Japan, Formosa, and Australia. Products requirements over the refining capacity are met by shipments from the Middle East. The Philippine Government is considering a refinery project, and last year passed a new law designed to encourage petroleum exploration in the republic. Some drilling is being carried out in the Philippines by a local company which began work before the war.

Development of domestic production and refining capacity has long been a goal of the Australian Government. Vacuum Oil Co., Pty., Ltd., the Standard-Vacuum subsidiary in Australia, brought on stream in 1949 a small refinery in Victoria designed mainly for the production of lubricating oils from New Guinea crude. Shell Co. of Australia has a 2,000-bbl.-daily refinery under construction in Victoria. A commonwealth agency studying postwar reconstruction recently recommended that a 10,000-bbl.-daily refinery be constructed in Australia. Shell has an existing refinery at Clyde, N.S.W., and Commonwealth Oil Refineries, Ltd. (Anglo-Iranian and the commonwealth government) operate a plant at Laverton in Victoria.

On the economic side of the oil situation in the Far East, one development of especial interest this year was the conclusion of an agreement between Standard-Vacuum and the British Government permitting the company to utilize sterling currency. The deal was one of several negotiated by American oil companies with the British Government to solve the problem created by the world dollar shortage and the restrictions on dealing in sterling. For Standard-Vacuum, the arrangement was of vital importance since the company's operations are to a large extent carried on in the sterling area. Under the agreement, the company receives an increasing percentage of sterling which it is allowed to spend in the sterling area. Dollars converted from these sterling proceeds are progressively reduced.

JAPAN

Production, bbl. daily	6,000	**Area, sq. miles**	147,690
Producing fields	5	**Population**	79,340,000
Reserves, bbl.	21,000,000	**Currency**	Yen
Refining cap., bbl. daily	47,500	**Value**	360 to the dollar

OIL production has been known in Japan since 1874. Greatest annual production was reached in 1916 with about 8,100 bbl. daily. The fields are in a narrow belt along the northwest coastal zone of the main Japanese island of Honshu and near the western coast of the northernmost island of Hokkaido. Production is derived from Pliocene and Upper Miocene formations.

Foreign Private Capital

Foreign private capital has played no part in crude-oil development in Japan since 1911. The Japanese Government 2 years ago expressed itself in favor of the entry of foreign private capital generally, but the possibility in respect to petroleum exploration is remote in view of left-wing and labor opposition. Several years before the war, the old Japanese Government with the backing of the military placed practically all the domestic industry under Imperial Oil Co., 50 per cent government-owned. A drilling subsidy to encourage exploration was provided in 1938.

During the last 3 years, with the assistance of technical advisers in the occupation forces, small but steady increases have been made in Japan's production. To accomplish this, the Japanese producers have worked against the disorganization resulting from the war, a somewhat weak financial position, and labor difficulties. Originally the industry was assisted by the Petroleum Exploration Advisory Group of the National Resources Section of the occupation forces. Last year, this group was replaced by the Petroleum Resources Development Promotion Council.

Yabase Field

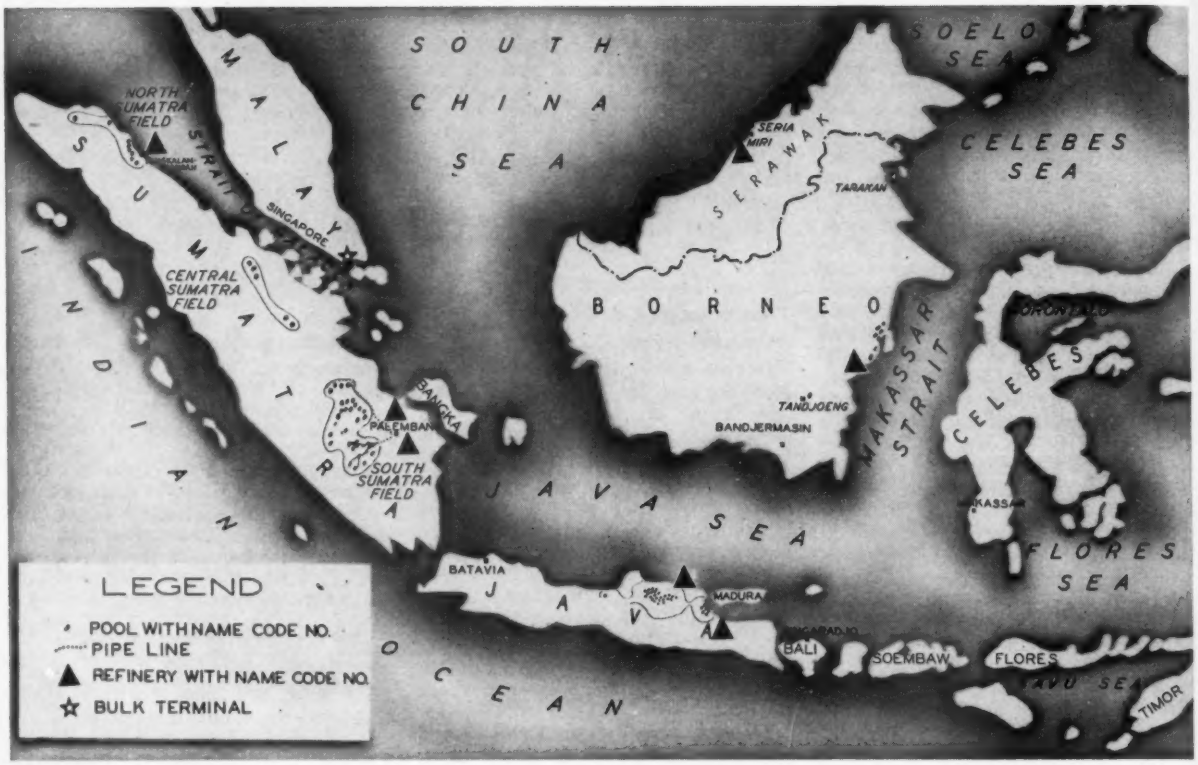
The most significant development in exploration in Japan since the end of the war was the discovery in 1949 of deeper production in Yabase field of the Akita district in Honshu. The new producing zone was discovered at about 3,800 ft. or about 400 ft. below the old formation. Further drilling has indicated the deeper zone underlies most of the field and has added at least 6,000,000 bbl. of new reserves to the previous total of 15,000,000 for all of Japan. This has been the principal factor in the increase of Japan's production to about 6,000 bbl. daily this summer.

Japan's refineries fall into two classes. There are a group of small field plants which handle the domestic output. The larger refineries are those located along the Pacific Coast and operating on imported crude. Prewar, they functioned under the close supervision of the government.

Bombing during the war destroyed about two-thirds of the prewar capacity of some 52,000 bbl. daily. When the Allies occupied the country in 1945, the remaining Pacific Coast refineries were shut down pending their possible removal for reparations. Late last year, occupation authorities reached a decision to reopen some of these plants. It was estimated the currency saving would be about 77 cents a barrel, or about $10,000,000 a year.

Other Foreign Interests

Although prewar, Tide Water Associated Oil Co. was the only foreign company with refining interests in Japan, the Pacific Coast Japanese refineries reopened, with one exception, are to some degree related to a foreign oil interest. These are the companies with marketing interests in Japan. Standard-Vacuum Oil Co. has bought into the Toa Nenryo plants; Nippon Oil Co. with two plants is a joint operation with Caltex; and Showa Oil Co. has a joint agreement with Shell. Maruzen Oil Co. has a marketing agreement with Union Oil Co. of California, and Tide Water continues in its prewar association with Mitsubishi. Engineers from these foreign companies assisted with the rehabilitation of the plants of their Japanese partners. The program calls for processing between 20,000 and 26,000 bbl. daily in the reopened refineries.



EAST INDIES: REPUBLIC OF INDONESIA

Production, bbl. daily	160,000	**Population**	72,000,000
Production, accum., bbl.	1,193,000,000	**Area, sq. miles**	733,000
Reserves, bbl.	1,050,000,000	**Currency**	Rupiah
Refining cap., bbl. daily	167,500	**Value (official)**	26.3 cents

OIL production is found in scattered areas throughout the East Indies Archipelago. Excluding British Borneo, the most important source at present is the South Sumatra region. Considerable production also is obtained from several fields in East Borneo, and lesser amounts from Java and western New Guinea.

Practically all the oil produced in the East Indies is by the Shell organization and Standard-Vacuum Oil Co. (Standard Oil Co. [N. J.] and Socony-Vacuum Oil Co., Inc.). The only exceptions are in central Sumatra where Nederlandsche Pacific Petroleum Mij. (Standard Oil Co. of California and The Texas Co.) is developing Minas field, and in western New Guinea where Nederlandsche Nieuw Guinee Petroleum Mij. (Shell, Standard of California, Texaco, and Standard-Vacuum with Shell the operator) has about 5,000 bbl. daily from Klamono field, first opened in late 1948. In the Australian territory of eastern New Guinea, Anglo-Iranian Oil Co., Ltd., and Standard-Vacuum, together with minority Australian capital, are carrying out an intensive exploratory program through Australasian Petroleum Co., Pty, Ltd.

Unsettled conditions arising out of formation of the new Indonesian Government delaying full-scale rehabilitation work in nearly all areas of the East Indies in the years immediately after the war. While certain parts of Java and North Sumatra are closed to company operations, by and large activities are now back to or above the prewar level. The Indonesian Government's Central Bureau of Statistics in Djakarta recently pointed out that Indonesian petroleum production is almost at the prewar rate. During the first half of this year production averaged 613,099 tons a month (about 155,000 bbl. daily) compared to 662,400 tons monthly in 1939. This does not include production from the Vogelkop area (Klamono) of western New Guinea.

South Sumatra Region

Rehabilitation work in the South Sumatra area by Standard-Vacuum and Shell has been so successful that the 1950 production from this area is expected to exceed 85,000 bbl. daily, the old prewar rate. The crude is processed in two refineries, the Shell plant at Pladju and the Standard-Vacuum installation at Sungei Gerong near Palembang.

The South Sumatra area is one of the three subbasins into which the larger basin stretching along the east coast of Sumatra is divided. This most prolific of the three areas has 43 fields which have produced a cumulative total of nearly 475,000,000 bbl. Central Sumatra, where exploration is made more difficult by swamps and jungle, includes Minas field now under development, and Lirik field, proved prewar by Standard-Vacuum and expected to be developed to an output of about 7,500 bbl. daily. North Sumatra, still partially closed to exploration and development, had 12 fields before the war. The crude was refined in the Shell refinery at Pangkalan Brandan but this plant was completely destroyed during and shortly after the war.

Central Java; Borneo

Some progress is now being made with rehabilitation of the fields near Tjepu in central Java. Prewar production in this area was about 16,500 bbl. daily, refined in a small plant at Wonokromo (Surabaya). In the Indonesian part of Borneo, along the east coast of the island, production is obtained principally from the fields of Sanga Sanga, Sambodja, and Tarakan. All this crude is refined at Balikpapan except that from Tarakan which is marketable as produced. There has been some minor production in the islands between Borneo and New

Guinea, including Ceram which produced up to the beginning of the war, and Buton which yields asphaltic bitumen.

Shell.—The present world-wide Royal Dutch-Shell organization grew out of petroleum operations in the 1880's in what was then the Dutch East Indies. In 1880, A. J. Zylker, a Dutch tobacco plantation superintendent in Langkat in Sumatra, was led to oil seeps by natives. He took samples which showed it would yield good-quality kerosine, and in 1883, obtained a 75-year mining concession from the sultan of Langkat. The first well in 1884 was inconclusive, but the second was brought in in June 1885 at about 72 ft. and a production of about 5 bbl. daily.

This Telaga Toenggal 1 discovery well, which later increased its output to 165 bbl. daily, was still producing in 1942 when Dutch engineers destroyed it in the face of the Japanese invasion. Zylker in 1889 returned to Holland and exchanged his concession for stock in a new company which he undertook to organize. This company, originally The Royal Dutch Co. for the Working of Petroleum Wells in the Netherland Indies, was formed June 16, 1890. By the spring of 1892, the company had built the Pangkalan Brandan refinery, and launched into the marketing of kerosine. J. B. Aug Kessler was manager of the company in the Indies at this time, and in 1896, he engaged H. W. A. Deterding, who was to build the company into a world-wide concern.

Standard-Vacuum.—The other leading company in Indonesia, Standard-Vacuum, also has a long history of operations in the East Indies. Marketing activities in Indonesia by its predecessor companies predate the year 1898 when the first Standard Oil Co. of New York office was established in Java. Before that, case oil (two 5-gal. tins to a wooden crate) was shipped by sailing vessel from the United States by the company to Javanese marketing agents.

The present Standard-Vacuum producing and refining subsidiary, Standard-Vacuum Petroleum Mij. (SVPM) was incorporated in The Hague in 1912 as Nederlandsche Koloniale Petroleum Mij., a subsidiary of Standard Oil Co. (N. J.). Some production was subsequently found, and a small skimming plant, since abandoned, was built during the period 1914-22 in central Java at Kapuan. In 1922, a prolific oil sand was discovered at Talang Akar in South Sumatra, and a 3,500-bbl.-daily refinery built at Sungei Gerong. Capacity was increased to 7,000 bbl. daily by 1929, and to 25,000 bbl. daily by 1931. When it was destroyed by Dutch military personnel in 1942, the plant had a capacity of 45,000 bbl. daily. In 1942, the producing wells were plugged, and the 81-mile pipe line to the fields dynamited.

Rehabilitation of the properties began in September 1946, and refinery production resumed a year later. The refinery now processes 64,000 bbl. daily, though no new equipment has been added. During the first 6 months of 1950, SVPM was producing from some 550 wells with a total daily average of about 65,500 bbl. Four field plants process casing-head gasoline. The company now markets its products through Australasia, the Far East, and South and East Africa, serving about a third of the world's population.

BRITISH BORNEO

Production, bbl. daily	**80,000**
Production, accum., bbl.	**192,000,000**
Reserves, bbl.	**500,000,000**
Refining cap., bbl. daily	**38,000**

Brunei:	
Population	**30,135**
Area, sq. miles	**2,226**
Sarawak:	
Population	**490,585**
Area, sq. miles	**50,000**
Currency unit	**Malayan dollar**
Value (2 shillings 4 pence)	**32.7 cents**

THE rise of British Borneo as a major producing area in the Far East ranks as one of the outstanding developments since the end of the war. With a production in excess of 80,000 bbl. daily, the area is now the leading oil-producing region in the British Empire.

British Borneo consists of three political units, North Borneo and Sarawak, which are Crown Colonies, and the native state of Brunei, a protectorate. By far the largest production comes from Seria field in Brunei. Miri, the smaller and older of the two fields, along with the rebuilt Lutong refinery, are in Sarawak. Royal Dutch-Shell subsidiaries operate both areas, British Malayan Petroleum Co., Ltd., in Brunei, and Sarawak Oilfields, Ltd., in Sarawak.

Discovery in 1911

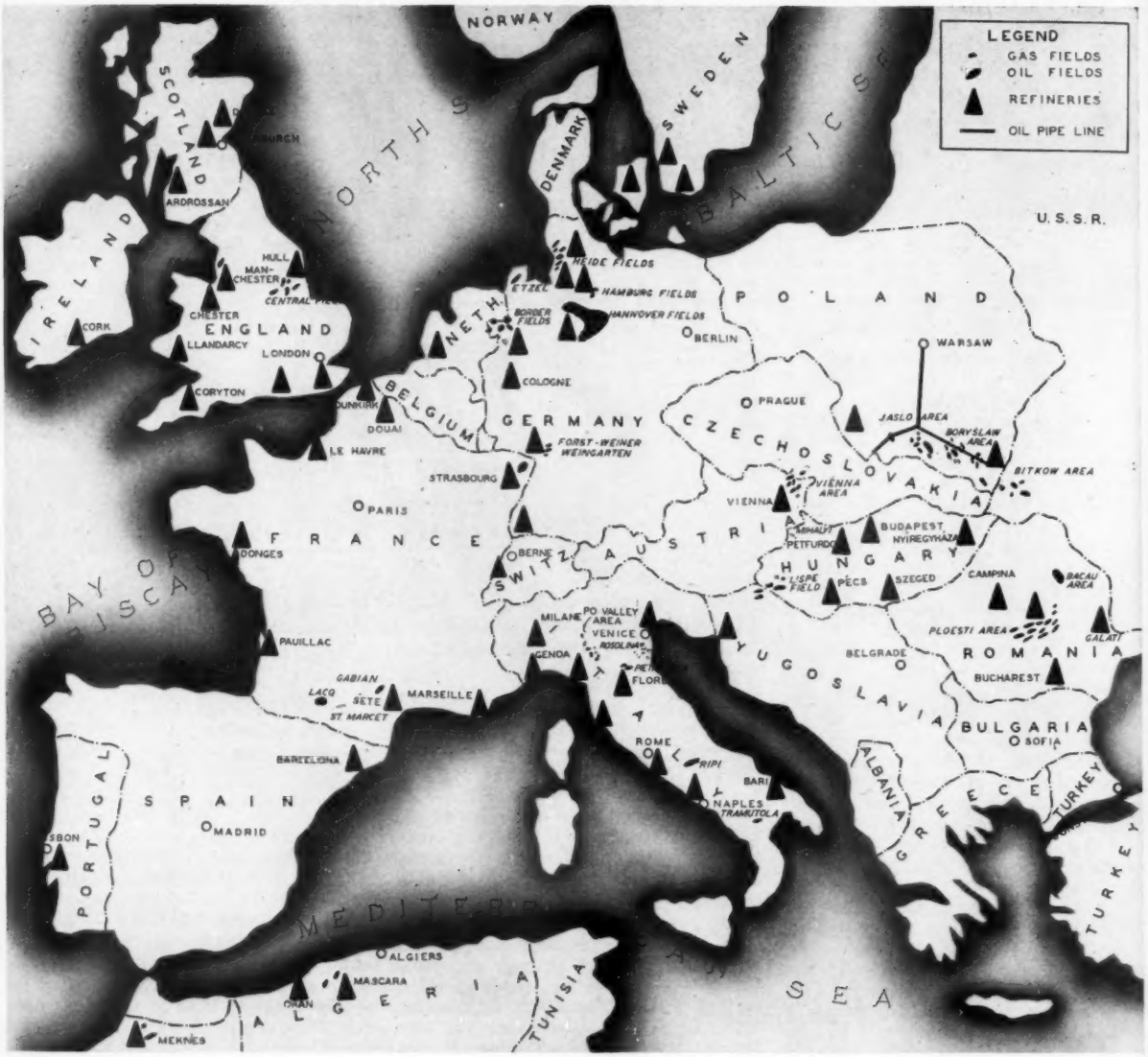
Oil was first discovered in Miri field in Sarawak in 1911, and the discovery well is still pumping. Discovery of Seria in Brunei came in 1929 after several years of geological investigation. Development of this field continued until the war. By directional drilling and using jetties, considerable offshore production was obtained.

Fields and refineries were destroyed in advance of the Japanese invasion. However, the Japanese had some success in restoring the area until Allied air attacks began in 1944. Bombings and destruction by the Japanese just prior to the liberation again devastated the oil installations. Their reconstruction and subsequent expansion is a tribute to the ingenuity and persistence of the officials and engineers who carried out the work.

Initially supplies and equipment obtained from the military forces were used as far as possible. A well-repair program was instituted, tankage was rebuilt, and the refinery rehabilitated and placed back in operation. In the 3 months immediately after liberation, 37 separate well fires were extinguished. The first tanker following the end of the war was loaded in March 1946 with crude for refining in Australia. Operations at the Lutong refinery were resumed in December of the same year.

The Lutong refinery is being replaced by a complete, modern, new plant. A program involving the construction of more than 700 houses for personnel has been undertaken. An extensive exploration program with seismograph, gravity meter, and surface geological study has been pursued throughout British Borneo.

All the wells on the older Miri field are on artificial lift, and remaining reserves in this field are known to be limited. Both Miri and Seria produce from Tertiary sands. The two fields are connected by pipe line to the refinery, and tankers are loaded from submarine lines at Miri.



WESTERN EUROPE—MARKED BY REFINING EXPANSION

West Germany . United Kingdom . France . Netherlands . Italy . Sicily

THE most outstanding single development in the oil industry of Western Europe since the end of the war has been the tremendous buildup in refining capacity. The end of this year finds most of the individual programs at least about half completed.

Prewar the total refining capacity in Western Eurpoe amounted to less than 400,000 bbl. daily. When most of the postwar construction is completed about 2 years hence, total capacity will be about three times what it was in 1938.

Primarily for economic reasons, national self-sufficiency in refining has been a major objective of the more important countries of Western Europe. Shortages of dollar, and in some cases, sterling exchange during the last 3 years have intensified the refinery-construction programs since obviously crude oil is cheaper to import than finished products.

Domestic refining has the further advantages of providing new industrial establishments and employment and offers the possibility of auxiliary petrochemical plants such as for detergents. When the Marshall-plan aid programs were drawn up, refinery construction held a prominent place in practically every country list. This assistance from the United States has made possible many of the wholly European projects. Other plants are being built in Western Europe by American oil companies out of their own dollar resources, though in some cases with a guarantee of profit convertibility.

A great deal of effort and money, some since the war provided by the Economic Cooperation Administration, has gone into the search for oil production in Western Europe. The results to date have not been particularly significant in terms of over-all impact on world oil supply.

Western Europe's domestic output now amounts to about 40,000 bbl. daily. Although this is double what it was 10 years ago, it still represents

WORLD-WIDE OIL REPORT

less than 0.5 per cent of total world production. It compares with a total Western Europe demand of about 550,000 bbl. daily.

It is one of the maxims of the oil business that sources of production as a rule are found at great distance from the major areas of consumption. Before the war, Western Europe drew on the Caribbean and to some extent on Russia and Romania for its petroleum supply. These have been replaced to an increasing degree by the Persian Gulf which is 6,000 miles or more distant from Western Europe's refineries but still the best adapted and most available source.

The relatively small domestic production in Western Europe had its beginnings long before the days of Colonel Drake in the United States. The French were mining oil in the seventeenth century near Nimes. The shale-oil industry of Scotland recently marked its one hundredth anniversary. Yet despite this history and the exploration effort in the last 50 years, Western Europe has no major fields comparable to those in Venezuela, the Middle East, or southwestern United States.

Western Germany's 22,000-bbl. daily output makes up more than half the crude production of Western Europe, and this country has shown the most encouraging exploration results in the last 2 years. France has been carrying out an ambitious exploration program which early this year resulted in a new field near the Spanish border. Italy, which some geologists consider the most promising country in Western Europe, is expanding its gas production along with some light crude.

With an extensive system of waterways and seacoast facilities, Western Europe depends mainly on water transportation for movement of oil. The few pipe lines that exist are mainly supplementary to this system. The lengthiest lines are those supplying natural gas in the St. Marcet region of France and in the Po Valley of Italy.

From the economics standpoint, Western Europe has long been tied to coal as its primary source of energy. Oil, however, has been increasing in usage, in most countries as much as government controls of one kind or another will allow. All of non-U.S.S.R. Europe is now estimated to consume about 50 bbl. of oil per capita annually. This compares with nearly 600 bbl. per capita in the United States, and 365 bbl. in Canada.

WEST GERMANY

Production, bbl. daily	**22,000**
Production, accum., bbl.	**94,000,000**
Reserves, bbl.	**260,000,000**
Refining cap., bbl. daily	**111,900**
Population	**49,732,000**
Area, sq. miles	**96,600**
Currency	**Deutsche mark**
Value	**23.8 cents**

SEVERAL developments over the last 3 years have given considerable encouragement to the West German oil industry. New-field discoveries along with extensions of some of the older producing areas have brought crude production to a level which this year probably will equal or exceed the 1940 record.

In refining, progress has been made in restoring some of the prewar capacity, and the refining needs of West Germany have been clarified as a result of action of the oil committee of the Organization for European Economic Cooperation in Paris.

Shortly after the war, at least one Allied expert who surveyed the German producing industry placed a rather low estimate on its possibilities. Subsequently, however, several field discoveries were made, especially including the Emsland area near the Dutch border. Early this year, the German Geological Research Office reported that West Germany's reserves amount to some 260,000,000 bbl., reflecting an increase of 80 per cent over a period of a year.

West Germany's present production of approximately 22,000 bbl. daily is to a considerable extent due to continued development of the older fields. In the first half of this year, 80 per cent of the increase in production over the first half of 1949 came from the older fields. The effect of the 1949 and 1950 discoveries—Ruehlertwist, Scheerhorn, Quakenbrueck, and Suderbruch—is expected to be reflected increasingly in the total production during the next few years. West Germany's production may exceed the 1952-53 estimate of about 29,000 bbl. daily which was made last year by a German investigating committee.

Along with several German-owned companies, Standard Oil Co. (N.J.), Socony-Vacuum Oil Co., Inc., and Shell, through German affiliates are participating in exploration work in Germany. Of especial interest was the commencement earlier this year of a well being drilled in the tidelands from a platform off Cuxhaven on the North Sea at the mouth of the Elbe River. In exploration work, more attention is being given to the areas of southern Germany which are not now productive to any important extent.

In connection with German refining major problem arises as a result of the country's coal production. With coal used predominantly for heating, fuel-oil production must be kept at a minimum to conform to the market pattern. Oil officials in West Germany have for several years insisted on the necessity of considerable cracking and hydrogenation capacity to achieve this goal.

Early this year, the OEEC oil committee in Paris approved German plans for new refineries and for the addition of cracking units at existing plants. The Paris organization agreed that, in addition to the already existing cracking plants of Olex at Hamburg - Finkenwerder, Gewerkschaft Deurag-Nerag at Hanover-Misburg, and Wintershall, A.G., at Salzbergen (total capacity about 10,000 bbl. daily), other cracking units with a total throughput of about 22,000 bbl. daily, are to be built. Later this total would be increased to about 30,000 bbl. daily by the construction of a cracking unit at Jersey Standard refinery in Hamburg-Harburg.

A new refinery of about 12,000 bbl. daily capacity is being built under this program by the German producers operating in the Emsland. Cracking here also is planned to increase motor-fuel production. The existing German refineries have been running at a recent rate of approximately 60,000 bbl. daily.

West Germany obtains gas production from a field at Bentheim. A 48-mile line from this field now delivers about 18,000,000 cu. ft. daily to Huels, near Marl. Oil pipe lines in West Germany consist of short lines carrying crude to nearby rail or water terminals. A 9-mile, 5-in. line has been under construction from Ruehlertwist field to a railway at Osterwald in the Emsland. Completion of this line will allow production of the now shut-in wells in the field.

WORLD-WIDE OIL REPORT

UNITED KINGDOM

Production, bbl. daily	**1,000**
Production, accum., bbl.	**4,500,000**
Reserves, bbl.	**3,400,000**
Refining cap., bbl. daily	**191,500**
Population	**51,000,000**
Area, sq. miles	**94,279**
Currency unit	**Pound sterling**
Value	**$2.80**

THE oil industry operated by British nationals at home and abroad is second only to that of the United States. The two principal international British companies are Shell and Anglo-Iranian Oil Co., Ltd. Other British companies have important interests in such countries as Trinidad, Venezuela, Ecuador, Peru, India, Burma, and Canada.

While London is headquarters for these purely British companies and their affiliates such as Kuwait Oil Co., Ltd., and Iraq Petroleum Co., Ltd., the city in the last few years has become an increasingly important center of activity for some of the larger American companies. Because of the dollar shortage and under controlled arrangements for the use of sterling, these American companies have turned to the small but growing British equipment industry for the needs of their foreign operations. Many of the new European refineries are being built with a minimum use of American equipment.

In Forefront of Expansion

The United Kingdom itself has been in the forefront of the expansion of the European refining industry. Projects now building will give the country a capacity of more than 400,000 bbl. daily in the next 2½ years. These new English refineries will be the most technically complete and modern in Europe including such facilities as catalytic cracking and polymerization.

The remarkable expansion which refining in the United Kingdom is now undergoing represents an almost complete reversal of the governmental policy in the 1930's. Unlike the French, there was little effort to develop a major refining industry in the United Kingdom before the war. Total throughput capacity in the country in 1938 was about 90,000 bbl. daily.

The refining capacity which is expected to be attained in the United Kingdom by 1953 will meet about 90 per cent of the estimated consumption of the country at that time. The crude for the new United Kingdom refineries will come from the Persian Gulf, using in many cases supertankers of 26,000 tons and more which are now being built.

The refinery expansion in the United Kingdom is being carried out principally for four companies—Shell, Anglo-Iranian, Standard Oil Co. (N.J.), and Socony-Vacuum Oil Co., Inc., in partnership with Powell Duffryn, Ltd. The ECA is assisting with the Shell and Anglo-Iranian projects.

Anglo-Iranian is working on the final stage of expansion of its Llandarcy, Wales, refinery, designed to improve product quality and make operations more flexible at this 46,000-bbl.-daily plant. Work is continuing on the Grangemouth project in Scotland, to be a 30,000-bbl.-daily refinery, and construction started this fall on the complete new refinery which the company is building in Kent on the Thames estuary.

Shell will have total capacity in the United Kingdom of about 130,000 bbl. daily when its projects are completed. The new 40,000-bbl. daily Shell Haven refinery went into initial operation recently. The new Stanlow refinery went on stream about a year ago. Shell also operates a former government plant at Heysham.

Through its British affiliate, Anglo-American Oil Co., Ltd., Standard Oil Co. (N.J.) is building at Fawley, near Southampton, what will be the largest single refinery in Europe. This 126,000-bbl.-daily plant is expected to begin initial operation by the end of 1951. It will replace the 18,000-bbl.-daily plant which Anglo-American has operated at Fawley. Facilities include a large catalytic cracking unit.

Site work began only recently on the 20,000-bbl.-daily refinery which Vacuum Oil Co., Ltd. (Socony-Vacuum and Powell Duffryn) is building at Coryton on the Thames River. This refinery will specialize in lubricating-oil production and is expected to be completed late in 1952.

Some other projects for refineries in the United Kingdom are still in the planning and consideration stage. These include a proposed refinery by the Caltex organization and Trinidad Leaseholds, Ltd., which market jointly through Regent Oil Co., Ltd. Along with the refineries being built in the United Kingdom are several important petrochemical plants. Cabot Carbon Co. and Philblack, Ltd., have carbon-black plants. Anglo-Iranian is a partner in a petrochemical operation at Grangemouth, and Shell has petrochemical plants at Shell Haven and Stanlow.

While the British companies control a large part of total foreign oil output, production in the United Kingdom itself continues to be almost insignificant in quantity. The few fields discovered shortly before and during the war have a total production of about 1,000 bbl. daily, virtually all of which is produced by D'Arcy Exploration Co., Ltd., and refined along with Scottish shale production in the Anglo-Iranian refinery at Pumpherston near Edinburgh. D'Arcy is Anglo-Iranian's exploration subsidiary.

For several years, D'Arcy has been the only company carrying on exploration in the United Kingdom. At the beginning of the year, the company held approximately 9,800 sq. miles under prospecting license. Its first licenses were taken in November 1935.

Water injection has resulted in increased production at Eakring field. The largest of any of the six fields in Nottinghamshire is Duke's Wood where a well-shooting program in 1949 halted the decline in production. No additions to the producing areas have been found in the last 3½ years.

Pipe lines in the United Kingdom are small local lines serving refineries and terminals except for the 60-mile, 12-in. crude line which Anglo-Iranian is now laying across Scotland to supply the expanded Grangemouth refinery. In the field of tanker transportation, British interests operate the world's second largest fleet. Total capacity is about 6,200,000 tons, compared to about 7,300,000 tons for the United States.

As in the United States, the large part of the tanker tonnage is owned and operated by subsidiaries of the oil companies. Shipyards in the United Kingdom since the war have been very active in tanker construction. Recently this work has been spurred by orders from American companies such as Caltex and Jersey Standard, which have made agreements with the British Government for the utilization of their sterling balances within the United Kingdom.

FRANCE

Production, bbl. daily	**3,000**
Production, accum., bbl.	**21,180,000**
Reserves, bbl.	**20,000,000**
Refining cap., bbl. daily	**363,100**
Population	**41,500,000**
Area, sq. miles	**212,659**
Currency unit	**Franc**
Value	**$0.0029**

THE petroleum industry of continental France is represented by nine companies operating 13 refineries and by four companies engaged in production and exploration activities. The principal French-owned company is Cie. Francaise des Petroles (C.F.P.) in which the French Government holds a partial interest.

C.F.P. holds a 56 per cent interest in Cie. Francaise de Raffinage which operates refineries at Gonfreville and La Mede. The other eight refining companies represent the principal international British and American companies — Shell, Caltex, Jersey Standard, Socony-Vacuum, and Anglo-Iranian—and three independent French organizations.

Of the four companies in the exploration and production field, the government holds full ownership of one, Regie Autonome des Petroles, and majority interest in two, Soc. Nationale des Petroles d'Aquitaine and Soc. Nationale des Petroles du Languedoc Mediterraneen. The fourth, Soc. Pechelbronn, produces the old field north of Strasbourg.

France's principal oil production outside the country is the 23.75 per cent interest in Iraq Petroleum Co., Ltd., which is held by C.F.P. Because of the lack of any large source of oil in French territory, the French consider that the expansion of the Iraq production is vital to their national interests.

Before the war, France had the largest refining industry in Europe. Refining operations were encouraged by concessions in the duty on crude oil as against products, and with a total capacity of about 165,000 bbl. daily, the country supplied virtually all its own needs. By the end of the war, this capacity had sunk to about 30,000 bbl. daily with only 3 of the 15 prewar plants escaping heavy damage.

As a result of the reconstruction program carried out with the assistance of the French Government, the country's refineries were able to regain 90 per cent of prewar capacity by January 1, 1948. Additional work since that time has brought capacity to its present level of in excess of 300,000 bbl. daily. Though capacity is expected to rise further to 350,000-360,000 bbl. daily, refinery work now is largely along the lines of product improvement and replacement of some uneconomic equipment.

French refinery production in the past has run to about 40 per cent fuel-oil production along with 23 per cent gasoline and 13 per cent fuel oil. Fuel oil is given priority because the French economy requires this fuel for industrial boilers and motors. The fuel oil is distributed principally to the national railroads, power stations, and industry in general.

France has a long history of oil production, though total output continues to be a fraction of the country's requirements. In the eighteenth century, the Pechelbronn mine was producing lubricants on a commercial scale. A hundred years ago, asphalt near Pau was used to pave the streets of some of Europe's cities.

In 1930, the French National Liquid Fuels Office began supporting oil exploration in metropolitan France and its overseas territories, particularly North Africa. In 1937, a special geological commission studied southern France, and a year later, the government company Regie Autonome del Petroles (R.A.P.) discovered natural gas at St. Marcet near Toulouse.

In 1945, after the war, the government gave the Bureau de Recherche du Petrole (Oil Prospecting Bureau) the task of carrying out a 5-year exploration plan financed mostly by public funds. Considerable work, including drilling, has been carried out by the Languedoc company in the lower Rhone area, and by the Aquitaine company in southwestern France near the Spanish border. ECA has assisted in the program, financing the purchase of drilling equipment.

The Pechelbronn company last year found limestone production near Soultz-sous-Foret in a well drilled somewhat deeper than the oil sand production. Early this year, the Aquitaine company made a discovery at Lacq near Pau in the Pyrenees foreland. The news of the discovery caused excitement in France at the time, and the field appears to hold the prospect of developing into a fairly substantial producing area.

To the east, R.A.P. has continued with the development of the St. Marcet area. A gasoline plant to extract light fractions has been completed, and gas-transmission lines extend as far as Bordeaux. The Standard Oil Co. (N. J.) organization has had an application pending for several years for an exploratory concession on a large area centering on Bordeaux but no action has been taken by the French Government.

Plans for several pipe-line projects are being studied in France. The largest of these is one which would move products from the Le Havre area's three refineries to Paris. The line as proposed would carry about 30,000 bbl. daily. A partially government-owned company has been created to carry out the project. In the south of France, two other lines have been planned. One would connect refineries of the Berre area with Lyon. An extension of this would link Lyon with Chalons and possibly branch out toward Switzerland. The Monnet Plan's Fuel Modernization Commission gave its approval to the construction of both these lines in 1946.

THE NETHERLANDS

Production, bbl. daily	**14,000**
Production, accum., bbl.	**12,230,000**
Reserves, bbl.	**50,000,000**
Refining cap., bbl. daily	**97,900**
Population	**9,636,000**
Area, sq. miles	**15,764**
Currency	**Guilder**
Value	**26.5 cents**

THE Dutch Schoonebeek field situated near the German border now meets approximately 30 per cent of domestic oil demand with its production of some 14,000 bbl. daily. The field was discovered prior to the war. Its development has been accomplished since the end of the German occupation.

The operating company is N. V. Nederlandse Aardolie Mij., owned equally by Royal Dutch-Shell and Standard Oil Co. (N. J.). The 25° A.P.I. gravity crude is refined in the Shell plant at Pernis. At present, Schoonebeek is the largest single field in Western Europe.

The prewar exploration program in the Netherlands was suspended when the Germans marched into the country in 1940. The work was resumed under German direction, and in May 1943 oil was produced for the first time in the Netherlands when about 6 bbl. of the heavy, viscous crude was bailed from a well completed in an upper Jurassic formation. In July of the following year, Well S3 was brought in flowing about 125 bbl. from the Valanginian sand of the Lower Cretaceous.

In their resistance to the German occupation, the Dutch in various ways prevented any large production from the field during the war years. Of more than 60 wells drilled during that period, only 2 turned out to be productive. After the liberation, however, development was rapid, although hampered to some extent by

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the lack of readily available equipment.

More than 2,700 acres are now considered to be proved in Schoonebeek. There is an average pay thickness of about 80 ft. in the anticlinal structure, with production obtained from around 2,600 ft. The operating company, concurrent with the field development, has done considerable wildcatting elsewhere in the Netherlands. Gas production has been obtained in an area about 25 miles west of Schoonebeek.

There are two refineries in the Netherlands, both located at Pernis near Rotterdam. One is the Shell plant of about 57,000 bbl. daily capacity. Newest of the refineries is the 20,000-bbl.-daily plant placed on stream last May by Caltex Petroleum Mij., a unit of the Caltex Group. This $18,000,000 plant, erected on 104 acres of builtup land, operates on Middle East crude and distributes its production throughout the Benelux countries and to parts of Germany and Switzerland reached by the Rhine.

ITALY

Production, oil	**Small**
Production, gas	**Growing**
Reserves, bbl.	**2,000,000**
Refining cap., bbl. daily	**102,500**
Population	**45,943,000**
Area, sq. miles	**119,800**
Currency unit	**Lira**
Value	**625 to the dollar**

LARGE-SCALE development and utilization of natural gas and further expansion of crude-refining capacity is taking place in Italy. The country for years has produced a few hundred barrels of oil daily, but last year's distillate discovery at Cortemaggiore appears to have been overemphasized and there have been no other reported oil discoveries since.

Total natural-gas production in Italy in 1940 amounted to an average of about 2,700,000 cu. ft. daily. This has been increased to about 91,000,000 cu. ft. daily at present, is expected to reach 190,000,000 cu. ft. by the end of 1951, and 210,000,000 cu. ft. by July 1952.

The main gas-producing area is in the triangle Lodi-Piacenza-Cremena in the Po Valley of northern Italy. Approximately two-thirds of the total is produced by Azienda Generale Italiana Petroli (AGIP), a state-owned organization, and the remainder by a number of medium and small companies in the areas of Polesine and Ferrera. Until 1948, these latter areas produced two-thirds of the country's total. AGIP-operated gas fields include Caviaga, Ripalta, and Cortemaggiore.

Of the three major pipe-line systems, the most important is that in the western part of the Lombardy Plain supplying the Milan area and owned by Soc. Nazionale Metanodotti, an AGIP subsidiary. This system earlier this year totaled about 210 miles. The company has plans for extensions to such centers as Turin and Genova. Another system is in the eastern part of the north Italian plain and has a length of about 300 miles, collecting the production of numerous smaller companies. The third system operates in the Ferrara-Florence area and has a length of about 72 miles.

American Firms Employed

The larger part of the exploration work being carried out in Italy is by the AGIP organization. It has used Western Geophysical Corp. and Santa Fe Drilling Co. to assist in its program. It recently contracted with North American Petroleum Gas Corp. and J. F. Pritchard & Co. for a 100,000,000-cu. ft. capacity gasoline plant to be built in Cortemaggiore field. In its exploration program, AGIP has been extending its work from the Po Valley into central and southern Italy. Aside from the oil exploration, it is of interest to the petroleum industry to note that a half a dozen or more rigs are employed in northern Italy in drilling for steam which is a supplementary natural power source.

For the last several years, the question of state vs. private development of Italy's oil and gas resources has been an issue in the country. The present somewhat obsolete mining legislation has retarded development by private capital. Continued state development, even though hampered by lack of skill, capital, and technical equipment, appears to be the prospect in Italy. At a minimum, mixed capital companies would be required.

SICILY

In Sicily, the situation is different. Though a part of Italy, it has regional autonomy, and following the passage of a new petroleum law, a Gulf Oil Corp. subsidiary this year took out exploration rights on an area in the southeastern part of the island. MacMillan Petroleum Corp. has long been interested in Sicily and still holds concessions and applications.

Refining. — Total refining capacity in Italy and Trieste in 1938 was approximately 30,000 bbl. daily. According to the original Italian submission to the ECA, this would be built up to nearly 300,000 bbl. daily by the middle of 1953. Throughout Italy, there are some 15 plants of less than 1,000-bbl. daily capacity.

The larger international British and American companies are represented in the larger Italian refineries. Standard Oil Co. (N. J.) and Azienda Nazionali Idrogenazione Combustibile (ANIC) formed a joint company, STANIC, which is now modernizing the Bari and Leghorn refineries. Before the war, these two plants operated at about 6,000 bbl. daily using Albanian crude.

Anglo-Iranian Oil Co., Ltd., is represented in Italy through its interest in the Venice refinery with Industria Raffinazione Olii Minerali (IROM). This refinery was taken over from AGIP, has a 12,000-bbl. daily capacity, and new and improved units are planned. In southern Italy, at Naples, Socony-Vacuum Oil Co., Inc., through an affiliate operates a 33,000-bbl. daily refinery which serves in part the company's export market out of Italy.

The Caltex organization with the Fiat company has plans for construction of a major refinery in northern Italy which will be supplied with crude through a pipe line from the seacoast. The Royal Dutch-Shell Group, which has a newly enlarged refinery at La Spezia, has been authorized to build a 40,000-bbl. daily capacity refinery at Apuania, a short distance to the north. Other plants scheduled for completion in 1951 and 1952 are those of S.A. Raffineria Padana Olii Minerali at Trecate, Raffineria Olii Minerali Affini at Milan, and Italia at Cremona. The Permolio organization has contracted for record small-size T.C.C. units at two of its refineries and a Perco unit at the third.

CANADA—DEVELOPING RECENTLY DISCOVERED RESERVES

Production, bbl. daily	**90,000**
Production, accum., bbl.	**181,100,000**
Reserves, bbl.	**1,500,000,000**
Refining cap., bbl. daily	**339,700**
Population	**13,800,000**
Area, sq. miles	**3,690,410**
Monetary unit	**Dollar**
Value	**96 cents**

CANADA is making rapid progress in the development of its recently discovered oil reserves in the west and in the construction of means to transport the fast-growing crude supply to the mushrooming refineries of the prairie provinces and on east to the fringes of Ontario.

Less than 4 years ago, Canada, with a per capita consumption of petroleum second only to the United States, was dependent on foreign sources for about 93 per cent of the crude that its refineries demanded. Currently, though demand has increased, the country supplies over 20 per cent of its needs with domestic crude and next year it will be supplying over 30 per cent. Canada has proven reserves (not fully developed) capable of supplying up to at least 50 per cent of the country's demand, and there are sufficient additional transportation facilities (pipe lines, storage tanks, and tankers) under construction or planned so that within a year or two the country will be approaching a self-sufficiency of 50 per cent. A further increase in the use of Canadian crude to meet the nation's demand is dependent on the oil-discovery and development rate and the construction of adequate transportation facilities.

A major factor in the rapid growth of Canada's oil industry has been the Alberta government's regulations covering exploration and development of crown lands. These regulations were designed to keep things moving and, as Alberta's potential production will testify, they do. The time allotted for exploration of a given block without drilling is limited to 3 years. If oil is discovered the explorer must give up half of the block within 3 months. The released portion is auctioned by the government and purchasers of the rights under such lands must commence drilling within 12 months. There is also a compulsory offset ruling in Alberta.

Western Canada

Population	**3,557,000**
Area, sq. miles	**2,631,731**

Western Canada is one of the most active oil-exploration areas in the world. Acreage under lease represents an area almost as great as the combined areas of Texas, Louisiana, Oklahoma, and Kansas. Well over 150 companies are doing active exploration and/or development work in Alberta, Saskatchewan, and Manitoba. These companies have 120 geophysical (principally seismograph) parties at work. They have nearly 70 rigs engaged on wildcats and another 70 on exploitation wells. Most of the field development is concentrated in the Leduc-Woodbend and the Redwater areas. Oil wells are being completed at a rate in excess of two a day.

The current boom in western Canada began with the discovery of Leduc in February 1947. Each year since that time has seen other significant discoveries and sizable extensions. The 650,000 sq. miles of potential oil-producing territory in western Canada is just now being scratched. The proven oil reserves of over a billion and a half barrels and the proven gas reserves of over 7 trillion cubic feet are believed to be but a teaser of what's to come.

Active exploration for oil in western Canada began in 1919. Norman Wells in Northwest Territory was discovered in 1920 but was not developed until World War II. In 1936 oil was discovered at the gas and distillate field of Turner Valley and oil production in this field reached a peak of 28,000 bbl. daily in 1942. Despite intensive exploration, which continues to this day, only two other fields, both gas-distillate, have been found in the foothills region. Sev-

eral small, heavy-oil pools were found in the southern part of Alberta and a larger field at Lloydminster on the Alberta-Saskatchewan line before the discovery of Leduc, but the total daily average production of these fields did not exceed 2,500 bbl. prior to 1947.

Transportation.—The biggest problem confronting the Canadian oil industry when it became obvious that Alberta's oil reserves offered far greater potential producing capacity than could be absorbed by the prairie provinces, was the fact that the oil fields were a minimum of 2,000 miles from the large marketing areas of eastern Canada. To tap these markets meant that crude would have to be laid down at Ontario's refineries at a price that would back out the crude coming in from the United States. This problem has been partially met by three principal construction jobs:

1. The construction of a 1,127-mile pipe line (known as the "Fastest Inch") from Central Alberta to Superior, Wis., passing through the important refining centers of Saskatchewan and Manitoba.

2. The construction of storage at Superior where 1,800,000 bbl. of crude can be stored during 5 months out of the year in preparation for the summer-time transportation by tanker to Ontario.

3. The construction of an adequate number of tankers large enough to carry a sufficient volume of crude to keep the over-all transportation cost per barrel low enough to meet competition from United States crude. In addition, a 3,500-bbl. refinery is being installed at Superior, Wis., which will soon be processing Alberta crude for United States markets.

The storage constructed at Superior will be filled this winter at the rate of 10,000 bbl. daily and next spring will see the beginning of tanker transportation to Ontario. During the navigation season crude will reach Superior at the rate of 50,000 bbl. daily. This rate can be nearly doubled by increasing the number of pumping stations on the pipe line, but it will take additional storage at Superior and Ontario, larger tanker shipments to Ontario, or perhaps United States outlets before such a volume of crude can be handled.

There exists a possibility of extending the market of western Canadian crude to Montreal. Such a step would involve large capital expenditures but could be justified if other markets cannot be developed to absorb Alberta's growing potential. The market on the west coast of Canada, however, is not considered large enough to support pipe-line construction through the Rocky Mountains. But, if additional volume is received by entering Washington and Oregon markets the project may be feasible.

Refining.—The rated refining capacity of western Canada will soon be in the neighborhood of 135,000 bbl. daily. By 1952 light crude refining capacity of the prairie provinces will have risen to 100,000 bbl. Alberta has seven plants with a total rated capacity of over 50,000 bbl., the most significant of which is Imperial Oil, Ltd.'s, 16,200-bbl. plant at Edmonton.

There are also seven refineries in Saskatchewan which have a total rated capacity of nearly 40,000 bbl. The plant at Regina, also Imperial's, is rated at 20,000 bbl. and is the largest in the province.

In Manitoba there are two small refineries, but Imperial is now constructing a 20,000-bbl. plant at Winnepeg which will go on stream next year.

At Norman Wells there is a 1,000-bbl. refinery which supplies products to the mining industry in the area and to vessels on the Mackenzie River and the Arctic Ocean.

In British Columbia, not a prairie province, there are three refineries with a total rated capacity of almost 30,000 bbl., compared to a demand in excess of 250,000 bbl. daily of products which is largely supplied by California refining capacity.

Eastern Canada

Population	**9,243,000**
Area, sq. miles	**1,058,679**

The development of oil and gas production in eastern Canada is principally history. Though some minor oil and gas discoveries have been made in recent years and some exploratory and development drilling is being carried on at the present time, most of the 18,000 wells that have been drilled in eastern Canada were drilled prior to 1900. Eastern Canada reached its peak production of nearly 1 million barrels daily in 1900.

Except for a small amount of production near Moncton, N. B., the province of Ontario accounts for all of the oil and gas produced in eastern Canada. A small pool at Becher, opened in 1946, is producing about two-thirds of Ontario's current daily average production of only 800 bbl. This insignificant production compares with the area's demand for over 200,000 bbl. daily. The accumulated production for eastern Canada is only 30,000,000 bbl.

Refining.—Though eastern Canada plays practically no part in the country's crude-production picture, it is here that two-thirds of the nation's current refinery capacity is located. At present these refineries are fed with foreign crude. Quebec is the biggest refining province in all of Canada. There are four plants in East Montreal with a total rated capacity of nearly 135,000 bbl. daily. In Ontario there are three plants with a total rated capacity of 66,000 bbl. Imperial's 52,000-bbl. plant at Sarnia dominates the refining capacity of the province. Nova Scotia has but one refinery, a 22,000-bbl. plant at Halifax. The only other operating refinery in eastern Canada is a 300-bbl. plant at Moncton, N. B.

Next spring, crude from the prairie provinces of the west will begin being laid down in Ontario at a price that will back out some of the crude now imported from Illinois and the Mid-Continent area of the United States.

MEXICO—ATTENTION FOCUSED ON ISTHMUS

Production, bbl. daily	**196,000**
Production, accum., bbl.	**2,428,000,000**
Reserves, bbl.	**1,300,000,000**
Refining cap., bbl. daily	**160,350**
Population	**23,425,000**
Area, sq. miles	**763,944**
Currency	**Peso**
Value	**$0.1160**

THE central plateau of Mexico occupies an area of 15,000 sq. miles at an altitude of 6,000-8,000 ft. The Sierra Madre ranges are other distinguishing features of Mexico's geography. This country, the third largest in Latin America, has a coastline over 6,000 miles long, and varies in width from about 750 miles on the north to 140 miles in the south across the Isthmus of Tehuantepec.

Isthmus fields.—First important discovery in the isthmus oil fields of Mexico was in 1923. These fields are of secondary importance relative to the Tampico-Tuxpan fields, but recently attention has been focused on the isthmus region with the drilling

of a number of wells in the Tortuguero and Xicalango area by Mexican-American Independent Co. operating under a percentage contract with Petroleos Mexicanos. (An account of the Mexican-American Independent operations are presented elsewhere in this issue.) The Tobasco basin and the Salt basin are the areas with best oil possibilities in the isthmus.

Tampico basin.—Some 90 per cent of Mexico's oil has come from the 1,600-sq.-mile Tampico basin where production is mostly from the Middle and Upper Cretaceous limestone. The Tampico-Tuxpan embayment includes the following districts: (1) Ebano-Panuco, (2) Golden Lane, (3) Poza Rica. Production in the first of these is from the Tamaulipas and San Felipe limestone in the Middle Cretaceous. The Golden Lane district fields once comprised the most important producing area of Mexico but now have relatively small reserves. Since 1935 the Poza Rica district has been Mexico's leading producing area with most of its production coming from the Tamabra limestone.

Of 87 wells drilled in the Tampico zone during 1949, 30 were exploratory wells which resulted in 11 new discoveries, location of 4 new producing structures within old fields, and 2 extensions. The 57 development wells that were drilled yielded 41 commercial producers. Total number of wells drilled in Mexico in 1949 (exploratory and development) was 162 of which 97 were producers.

Field plant.—Field installations for natural-gasoline manufacture, crude stabilization, gas desulfurization, and sulfur recovery and pressure-maintenance facilities have been under way in Poza Rica field. Total cost of these installations is about $10,000,000. A new Pemex absorption plant was completed in 1947 at a cost of $6,000,000. This plant handled 80,000 M.c.f. daily in 1949 with extraction of 3,400 bbl. of natural gasoline per day. Capacity of the plant is being expanded presently to 116,000 M.c.f. per day and additional extraction of 1,500 bbl. daily of hydrocarbon liquids.

In northeastern Mexico, Reynosa field was discovered by Pemex.

Mision and Valadeces gas and distillate fields near the border are located in this area. Pemex has also found oil in Monterrey field and has producers in Cano field located between Reynosa and Matamoros. It is believed by Pemex engineers that an intensive wildcatting program in northeastern Mexico would result in considerable implementation of Mexico's crude-oil reserves.

Drilling activity.—The number of rigs drilling in Mexico have shown an upward trend, with 70 rigs reported active toward the latter part of 1950. Pemex was operating 55 rigs, the remainder being contracting-company rigs. Ten of the Pemex rigs were being used in wildcatting. Total footage drilled during the first half of 1950 was reported by Pemex to be 23 per cent greater than for the similar period of 1949. Estimated Mexican production for 1950 is 194,000 bbl. daily with 65 per cent coming from the Poza Rica district, 13 per cent from the Ebano-Panuco, 10 per cent from the Golden Lane, and 9 per cent from the isthmus fields.

Pemex refinery program.—Completion this year of the 30,000-bbl. Salamanca refinery was the latest step in Mexico's refinery construction program. The facilities at Salamanca include thermal cracking and catalytic desulfurization units. Poza Rica crude is processed at Salamanca. Construction of a 4,000-bbl. plant at Reynosa is in progress. This will process crudes from the Reynosa and Cano fields of northeastern Mexico. Modernization of the Minatitlan refinery is also contemplated. A refinery is planned at Monterrey but this must await further development of production from northern fields.

SOUTH AMERICA—ONE OF WORLD'S MAJOR OIL AREAS

Venezuela . Colombia . Peru . Argentina . Ecuador . Bolivia . Chile . Trinidad

Brazil . Uruguay

IN South America geography and climate have a particularly close influence on the economics of oil exploration and development. Some three-fourths of the continent lie within the tropics; the salient feature of geography is the great Andean Mountain chain running along its western length. The highlands of eastern Brazil and the Guiana highlands in the north make up minor mountain systems. The great plains and jungles of the interior consist of: (1) the Amazon River Basin with an area of roughly 2,500,000 sq. miles or five-sixth the area of the United States, (2) the area drained by the Parana and Uruguay rivers flowing

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into the Rio de la Plata estuary, and (3) the Orinoco River Basin.

In contrast to the vast interior plains, South America has relatively small coastal plains. This is especially marked on the Pacific side with its attendant lack of large protected harbors, although on the eastern coast harbor facilities are relatively more favorable.

One of the major areas of the world with respect to current and potential oil production extends from Colombia, Venezuela, and the island of Trinidad on the north to the southern regions of Argentina and Chile. (This has at times been designated, in the over-all sense, as the "Andean" basin.) The most important oil area of South America is in the north, forming part of the Caribbean-Gulf of Mexico producing region. South America's share of world production in 1939 was only 15 per cent as compared to approximately 20 per cent in 1949. Increase in South American annual production has been from 272,880,000 bbl. in 1938 to 576,477,000 bbl. in 1949. (Figures include Trinidad production.) This increase of 110 per cent or better than double the 1938 production, is due mostly to developments in Venezuela, the world's second largest producer of crude oil.

Venezuela (and the island of Trinidad), Colombia, and Peru are the oil-exporting countries of South America. Argentina, Bolivia, and Ecuador have substantial production but are not major or net exporters. Economically important countries with limited or no production are Brazil, Chile, and Uruguay. Chile has just recently become an oil producer and is aiming toward future self-sufficiency in this commodity. The nations of South America may also be classified with regard to the extent of foreign participation in oil activities. Venezuela, Colombia, Peru, and Ecuador permit outside participation, while the others have rather limited foreign participation or none.

Many long-range and complex economic, political, and social factors are tied in with United States participation in development of South American oil resources, further complicated by more or less temporary situations such as the dollar shortage. Events of the past 10 years have strongly emphasized the economic interdependence of the Western Hemisphere, although such interdependence has been shaping up for a longer period than that. It has been stated that the practical essence of the "good neighbor" policy is establishment of a long-range economic relationship by which imports of South American products are balanced against export of United States know-how and capital goods for development of Latin-American agriculture and industry. Such a relationship holds particular significance for the oil industry.

Refining capacity on the South American Continent is at present approximately 565,000 bbl. per day of crude throughput or about 5 per cent of world capacity. Here again the greatest expansion has taken place in Venezuela which now has a refining capacity of about 300,000 bbl. daily. If the capacities of refineries on the islands of Aruba, Curacao, and Trinidad are added to that of South American mainland the total approaches 1,300,000 bbl. daily or 11 per cent of world capacity.

VENEZUELA

Production, bbl. daily	**1,600,000**	**Population**	**4,643,000**
Production, accum., bbl.	**5,604,000,000**	**Area, sq. miles**	**330,000**
Reserves, bbl.	**9,000,000,000**	**Currency**	**Bolivar**
Refining cap., bbl. daily	**284,770**	**Value**	**$0.3010**

THE highlands of the west and north of Venezuela, though covering a relatively small area, contain the greatest portion of the population. The lowlands of Lake Maracaibo are handicapped by severe tropical climate, tempered somewhat by the cooling trade winds, and are the location of the major oil fields of western Venezuela. Through the center of Venezuela runs the llanos or plains occupying about one-third of Venezuela's area which are drained by the Orinoco and its tributaries. Principal oil fields of eastern Venezuela are located in the states of Monagas, Anzoategui, and Guarico. The Guiana highlands are in the south bordered by Brazil and Colombia. This forested plateau covers half the area of Venezuela and is rich in mineral deposits but due to its inaces-

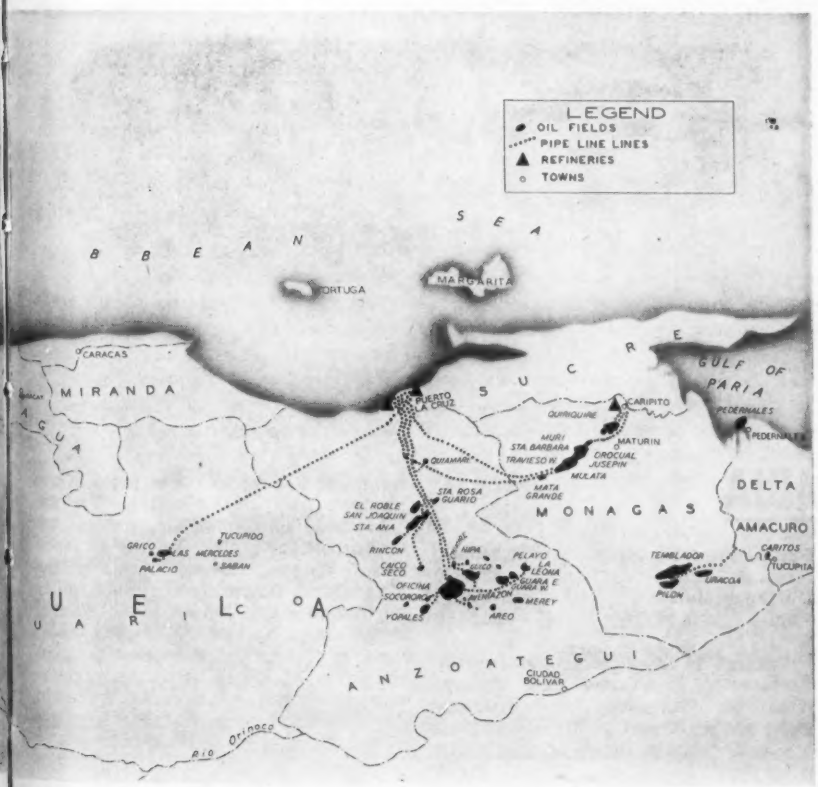
sible terrain and tropical heat is virtually without population. In the past speculation as to the rich mineral deposits of this area have been tempered by questionable profitability of operation. However, such speculation has been laid to rest by the recent discovery and development of large iron ore deposits by United States Steel and Bethlehem Steel Co. in the north of the Guiana highlands.

Production.—Following 1923, an oil boom developed in the Lake Maracaibo region with the discovery of wells having very high initial production. Close to 70 per cent of current production is from western Venezuela, chiefly from Bolivar Coastal field, but production from fields in the llanos of eastern Venezuela has been increasing. Possibly the most notable development of production has been from the Cretaceous limestone in La Paz and Mara fields and the new Sibucara field northwest of Lake Maracaibo, with activity in deep drilling of the Cretaceous continuing. Production from the Cretaceous was 15 per cent of Venezuela's total in 1949 compared to 12 per cent in 1948.

Venezuela's production in 1948 averaged 1,338,794 bbl. daily, a production peak of 1,406,000 bbl. per day being reached in November of that year. During 1949 Venezuelan production was cut back due to the decreased world demand as reflected particularly by a slump in the heavy-gravity-crude market. However, production began to climb again following a low of 1,182,000 bbl. per day in April 1949, to a new high of 1,476,000 bbl. in November of that year. Total production for 1949 was 482,000,000 bbl. or an average daily of 1,321,000 bbl. During 1950 new peaks were reached with highs in June of 1,572,284 bbl., in August of 1,563,891 bbl., and in September of 1,586,036 bbl. An even higher production rate was indicated for the remaining months of 1950. The average daily production for the first 9 months of 1950 was 1,458,455 bbl. or an increase of 10 per cent over the similar 1949 period, according to Ministry of Fomento figures. This new record was obtained despite a shutdown of a major part of Venezuelan production due to a strike of short duration by union oil workers in May. Venezuelan reserves, according to Fomento estimates, were 7,931 millions of barrels at the end of 1949, and 8,233 millions of barrels as of January 1, 1950.

Government figures also show daily average production by companies for the first 9 months of 1950 as follows:

	Bbl.
Creole Petroleum Co.	666,116
Shell Group	451,323
Mene Grande Oil Co.	194,383
Socony-Vacuum Oil Co. (Venezuela)	34,450
Texas Petroleum Co.	26,245
Venezuelan Atlantic Refining Co.	21,576
S. A. Petrolera Mercedes	18,009
Sinclair Oil & Refining Co.	13,067
Pantepec Oil Co.	12,634
Richmond Exploration Co.	11,674
Phillips Oil Co.	7,886
British Controlled Oilfields, Ltd.	1,010
Guasare	82



Cretaceous production.—Average Creole production for 9 months of 1950 as listed above compares with total daily average of 624,505 bbl. daily in 1949 and 683,531 bbl. in 1948. Shell daily production was 409,983 bbl. in 1949 and 396,990 bbl. in 1948. Of the Shell Group's total operated production in 1949 some 47 per cent was from the Cretaceous limestone. While developing deep Cretaceous production in Mara and La Paz fields west of Lake Maracaibo the Shell Group was also continuing development of the new Sibucara field following high production of light-gravity crude from the Sibucara discovery well. Interest has also centered on Creole's Alturitas wildcat, described as a thorough test of Cretaceous oil possibilities in the district of Perija, State of Zulia. After drilling to 17,039 ft. this well was completed to produce from about 11,000 ft. The Alturitas thus becomes the deepest well drilled outside the United States, exceeding the previous depth record set by the Shell Group's CT-1 well on the Rio Catatumbo which went to 15,637 ft.

Conservation.—The Oficina Tecnica de Hidrocarburos (Hydrocarbons Bureau) of the Ministerio de Fomento has given careful consideration to Texas Railroad Commission methods in handling proration and conservation measures and has in fact sent some of its petroleum engineers through "postgraduate" work with the Texas Commission. Gas conservation is a prime concern of the Hydrocarbons Bureau whose figures show that of 1,400 M.M.c.f. daily produced in Venezuela by far the greatest part is vented or flared.

Several "combination" field plants have been constructed in eastern Venezuela which are related to the government's interest in conservation practices. One of these is the $6,000,000 "four purpose" plant in Mulata field operated by Creole to effect crude stabilization, crude desalting, gasoline extraction, and pressure maintenance. The plant was designed to handle 20,000 bbl. per day of crude and to process 60,000 M.c.f. daily using 20,000 M.c.f. per day for pressure maintenance. Creole has joint interest with Mene Grande Oil Co. and Pantepec Oil Co. in this plant.

Mene Grande Oil Co. operates pressure-maintenance facilities combined with gasoline extraction in West Guara field, having a gas capacity of 28,000 M.c.f. per day. Another Creole-operated field plant is located in Jusepin field for stabilization, desalting, and dehydration of 44,000 bbl. of crude per day and pressure maintenance. Original pressure-maintenance

WORLD-WIDE OIL REPORT

facilities at the Jusepin plant at 10,000 M.c.f. daily are now being increased to 25,000 M.c.f. daily at a cost of $2,250,000. In addition Creole operates a pressure-maintenance plant in Quiriquire field and a gasoline plant at Cumarebo.

In La Paz field of western Venezuela Shell Caribbean Petroleum Co. is building a natural-gasoline plant to handle 39,000 M.c.f. daily, with extraction of butanes and natural gasoline estimated at 93,000 gal. per day. Shell is also installing a similar plant in Mara field.

Other steps are in progress looking toward greater utilization of Venezuelan gas. Organization of the Venezuelan Atlantic Transmission Corp. was announced this year. Contract has been let for construction of some 220 miles of line for transmission of natural gas from Venezuelan Atlantic Refining Co.'s Placer field in the north of the State of Guarico to Valencia and the Caracas-La Guaira area. This will be Venezuela's first significant gas-transmission project.

Refinery expansion.—The latest refinery project to be completed in Venezuela is the Sinclair Oil & Refining Co. 35,000-bbl. plant at Puerto La Cruz which went on stream in October of this year. Earlier in the year the Creole Amuay Bay 63,000-bbl. refinery and the Venezuelan Oil Concessions, Ltd. (Shell), 60,000-bbl. Punta Cardon plant had been placed in operation on the Paraguana Peninsula. The Venezuelan Gulf Refining Co. (Gulf and Texas) 30,000-bbl. refinery at Puerto La Cruz also began operation. With the addition of nearly 200,000 bbl. daily during 1950, Venezuela's refining capacity now totals close to 300,000 bbl. per day for crude oil. Facilities for manufacture of lubricating oils are being built at the Punta Cardon refinery. Addition of lube-oil units at the 200,000-bbl. per day Shell refinery on the island of Curacao are also planned. Phillips Oil Co. has announced construction of a refinery and wax plant to operate on San Roque crude in eastern Venezuela.

COLOMBIA

Production, bbl. daily	**91,000**	**Population (est. 1947)**	**10,545,000**
Production, accum., bbl.	**486,000,000**	**Area, sq. miles**	**439,830**
Reserves, bbl.	**400,000,000**	**Currency unit**	**Peso**
Refining cap., bbl. daily	**23,840**	**Value**	**$0.5150**

WHILE Colombia, facing both on the Pacific and the Caribbean and in proximity to the Panama Canal, is favorably located for ocean commerce, the mountainous nature of much of the country is a great disadvantage to interior communication. Factors of geography and climate make oil exploration and development difficult and costly in Colombia as in certain other of the South American countries. Three great ranges of the Andes cover most of the western part of Colombia. On the other side of the mountains are the Orinoco River plains and the Amazon Basin jungles. Largest river is the Magdalena, flowing some 1,000 miles north and south between the central mountain range and the Bogota tableland. In Colombia as in other tropical countries of South America population has tended to concentrate in the highlands to escape the lowland heat and malaria.

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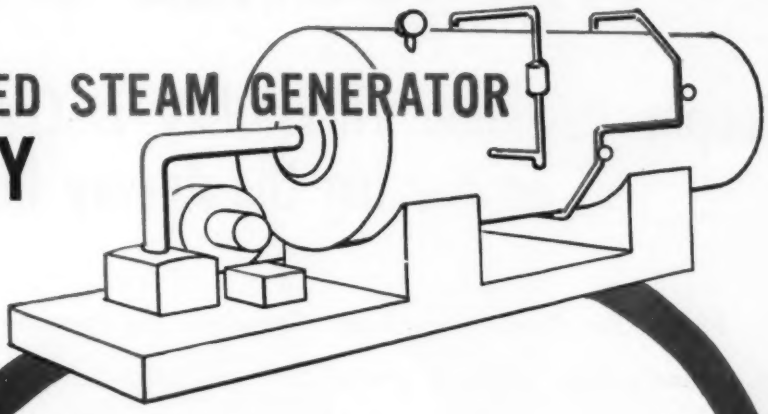

1

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Write for Bulletin 49

2

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Nalco SR-155 is a *complete* fuel oil additive. It replaces two, three or more single-purpose additives to: (1) keep storage tanks, fuel lines and burners free of sludge and gum; (2) prevent soot formation in the firebox and flues; (3) inhibit corrosion throughout the fuel system; and (4) act as a combustion catalyst to assure complete burning of oil. Fuel savings and reduced maintenance costs usually more than repay the cost of continuous SR-155 treatment — and very little SR-155 is needed per 1,000 gallons of fuel oil! Details on Nalco SR-155 will be sent on request.

Write for Bulletin 46

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ON THE WORLD'S LARGEST

Cooper-Bessemer flexibility is Creole's gain ...on the big Ulé-Amuay line

Power for Creole Petroleum Corporation's big, 143-mile crude line is furnished by 14 Cooper-Bessemer engines. All are modern, Type LS 8-cylinder units. This standardization naturally permits simplified operation as well as substantial economies in parts inventory and maintenance. But to achieve such standardization required engines with flexibility to operate efficiently on different type fuels.

For example, of the seven LS engines in Creole's Ule´ pumping station (shown opposite), two are operating as gas-diesels, burning only pilot charges of fuel oil. All seven will soon be operating as gas-diesels . . . all easily switched to 100% oil, or *any combination* of oil and gas, at will. At the Dabajuro station, midway on the line, there are 7 more LS-8's. Here these Cooper-Bessemers operate on crude from the line.

Full gas operation, 100% oil, gas-diesel, or speedy conversions from one to another . . . you'll find proved Cooper-Bessemers of the type and size you need, ready to give you the best there is in efficiency and over-all economy.

Right: six of seven Cooper-Bessemer LS-8 engines in Creole Petroleum Corporation's Ulé pumping station. Engines, direct-connected through a firewall to 8" x 24" triplex pumps, are rated 1000 bhp at 300 rpm. Rated capacity of each pumping unit is 50,000 bbl a day.

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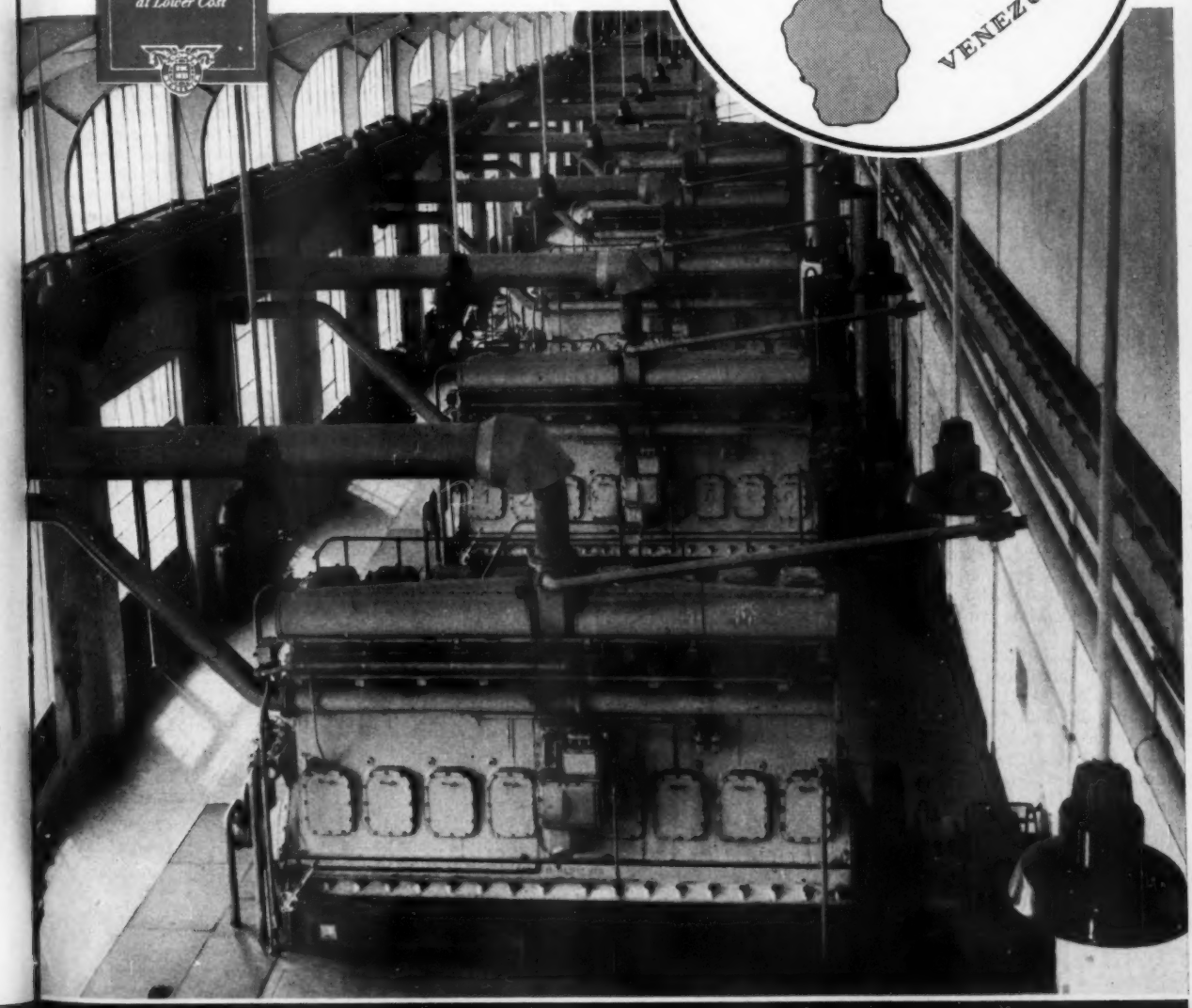

by Cooper-Bessemer

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(1918-19) by an American company at Infantas close to the Magdalena River and more than 300 miles from the Caribbean coast. This was the beginning of the DeMares concession which includes the fields of La Cira, Infantas, Colorado, and Galan, and is operated by Tropical Oil Co.

Total Colombian production for 1949 was 29,643,819 bbl., an increase of about 24 per cent over 1948. Of this, 40 per cent came from the DeMares concession, 32 per cent from the Barco, and 21 per cent from the Vondo concession. Estimated production for 1950 is 90,050 bbl. daily. While Colombian production stood higher than at any previous time, there was a serious decline in wildcatting. Following the end of World War II considerable interest was shown by United States companies in possible concessions located on the llanos (grassy plains) of the Orinoco Basin and coastal areas of Colombia. However, the number of wildcats decreased from 18 in 1948 to 12 in 1949. These exploratory tests resulted in only one gas producer in 1948 and one heavy oil discovery in 1949. However, Texas Petroleum Co. made a promising discovery with its Tetuan well in the upper Magdalena Valley, brought in Tetuan No. 2 in early 1950, had suspended drilling on Tetuan No. 3 at 3,459 ft., and was spudding a fourth well in this area. This company also spudded a test this year on the Caribbean Coast 12 miles east of Barranquilla.

In the Barco concession this year light Cretaceous production was discovered on the North Sardinata structure west of Petrolea. Colombian Petroleum Co. was also preparing to make a deep test in shut-in Rio de Oro field from which a 4-in. line had been laid to the Rio Catatumbo.

An exploration concession of 120,000 acres (the Balsamo block) in northern Colombia, about 50 miles south of Barranquilla, was acquired by Tropical Oil Co. This was taken as an indication that Tropical would continue active in Colombian exploration, although the 1,265,000-acre DeMares concession is due to revert to Colombian Government in August.

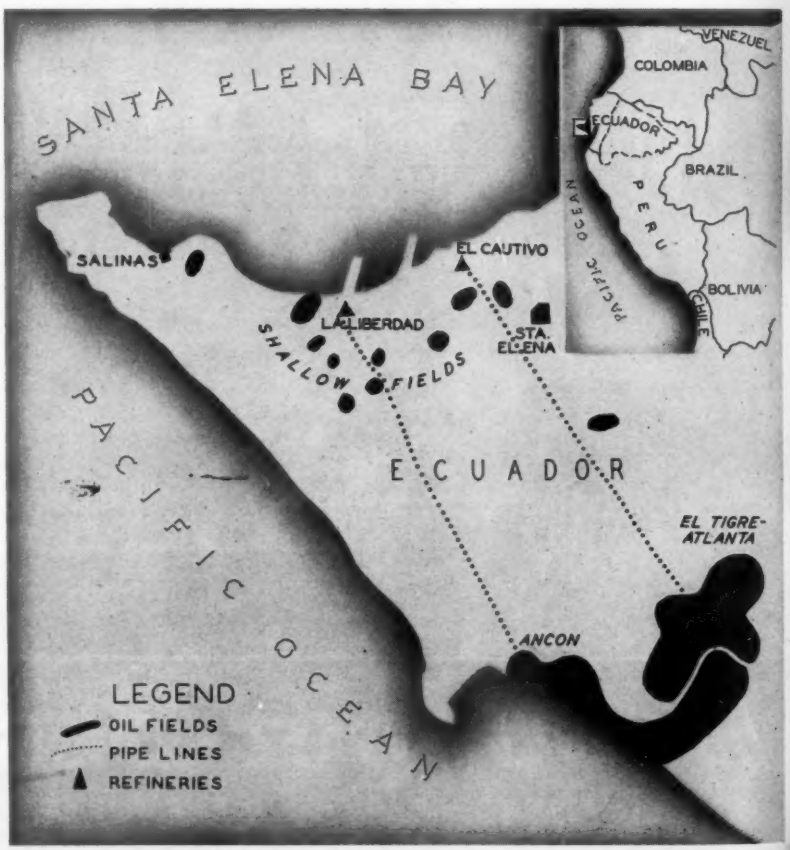
Colombian refining facilities consist of a 21,000-bbl. per day plant operated by Tropical Oil Co. at Barrancabermeja in the DeMares concession. This is a crude-distillation plant with some lube-manufacturing facilities but no cracking. A 700-bbl. per day topping plant is also in operation at Petrolea. These plants refined 8,549,751 bbl. of Colombia's 1949 production. Recent surveys of the Colombian oil industry have resulted in conflicting reports. With regard to refinery expansion alternative plans have been offered, one of which contemplates expansion (including thermal cracking) of the Barrancabermeja refinery, while the other favors, in addition, construction of a refinery at Mamonal. As of November 1950 the Colombian Government was reported studying two bids for future operation of the DeMares concession one of which involves revamping and expansion of the Barrancabermeja refinery.

ECUADOR

Production, bbl. daily	**7,300**
Production, accum., bbl.	**49,560,000**
Reserves, bbl.	**26,000,000**
Refining cap., bbl. daily	**4,400**
Population (est. 1947)	**3,400,000**
Area, sq. miles	**175,830**
Currency unit	**Sucre**
Value	**$0.045**

ECUADOR is located between Peru and Colombia facing the Pacific Ocean. The country consists of a small western coastal plain, two very high ranges of the Andes enclosing a narrow valley, and the forested plain of the Amazon Basin (Oriente) on the east. The oil fields of Ecuador are smaller than those of Peru, but fortunately are also located adjacent to the Pacific Coast. Production through 1950 was maintained at about 7,300 bbl. daily, nearly all of which came from the Santa Elena Peninsula. Major fields are the Ancon operated by Anglo-Ecuadorian Oilfields, Ltd., and El Tigre operated by Ecuadorian Oilfields, Ltd., which also has a 700-bbl. per day topping plant at Cautivo. Test drilling looking toward the extension of the Santa Elena production has been reported by Anglo-Ecuadorian. This company, which produced 1,859,480 bbl. in 1949 or about 70 per cent of Ecuador's total production, has also been adding to its 4,000-bbl. topping and lube plant to bring refining capacity up to match its crude production. A natural-gasoline plant was being completed by Anglo-Ecuadorian in the Santa Tomas area. Holdings in the El Oro concession in southern Ecuador were increased by Anglo-Ecuadorian which was making geological surveys in this area.

Surface geology and gravimetric work to be followed by test drilling has been in progress in the 2,000,000-acre concession leased by Manabi Exploration Co. along the Pacific Coast north of Santa Elena. There are three basins here with particularly good oil possibilities in the Tertiary section.



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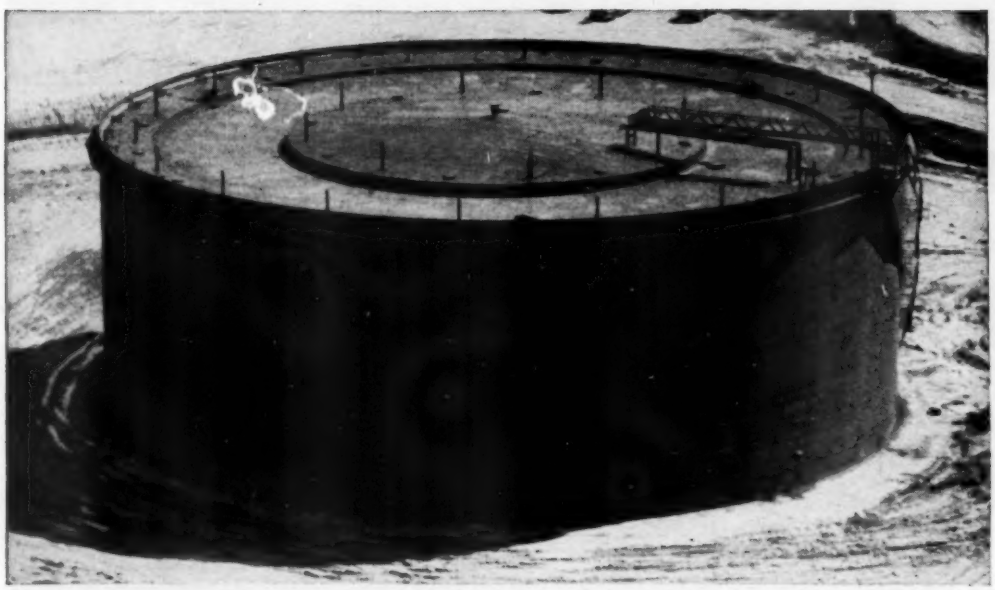

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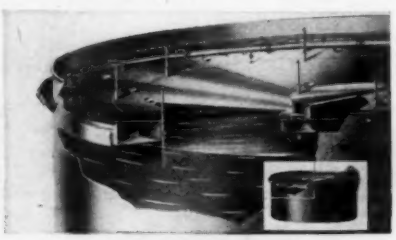

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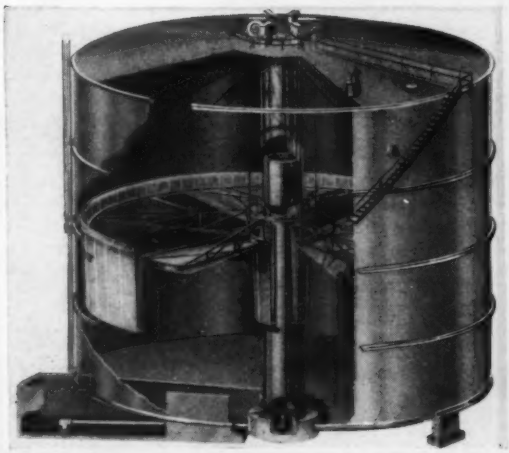

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WORLD-WIDE OIL REPORT

PERU

Production, bbl. daily	**40,500**	**Population (est. 1947)**	**7,038,809**
Production, accum., bbl.	**394,000,000**	**Area, sq. miles**	**482,258**
Reserves, bbl.	**170,000,000**	**Currency**	**Sol**
Refining cap., bbl. daily	**35,100**	**Value**	**$0.0650**

LACK of rainfall on its coast and the mountainous surface of much of the interior are the chief geographic and climatic characteristics of Peru. The main Andean Mountain chain and a subsidiary chain of mountains running close to the sea lend to Peru the geographic features typical in greater or lesser degree of the other west coast countries of South America. Peru consists of narrow coastal plain, mountain range of 200-250-mile width, and an Oriente or eastern region covering about one-half of the country and consisting of tropical forest. Due to the location of Peru in the belt of the southeast trade winds and prevailing wind direction over the Peruvian coast, much of the latter is desert. The coast has a maximum width of 100 miles, but the average width is 30-40 miles and in some places the mountains came right down to the sea.

Peru's important oil fields are located on the coast in the extreme northwest. Drilling in this coastal region began as early as 1870. United States interests entered Peruvian oil operations in 1915. The chief operating company at present is International Petroleum Co., a subsidiary of Standard Oil Co. (N. J.). At one time Peru was the chief oil-producing country of South America.

Peru's total production in 1949 was 14,796,092 bbl. or 40,537 bbl. daily, with 1950 daily production estimated at about the same amount. The La Brea-Parinas estate operated by International Petroleum Co. accounted for nearly 80 per cent of the total. Integrated operations of International included a complete refinery of 33,000-bbl. per day capacity including 6,600 bbl. of cracking capacity at Talara, westernmost city of South America. International also operates natural-gasoline plants processing a total of 50 M.M.c.f. daily. The Lobitos group of fields (Lobitos, El Alto, Los Organos) is operated by the British-owned Compania Petrolera Lobitos. A small topping plant and natural-gasoline facilities are located at Lobitos. The Peruvian Government's Empresa Petrolera Fiscal operates the Zorritos-Los Organos fields and a 1,000-bbl. per day topping plant at Zorritos. The isolated Ganzo Azul field in the Montana on the eastern side of the Andes is operated by Cia. Ganzo Azul which also runs the Agua Caliente 1,000-bbl. topping plant.

A number of United States com-

Are you looking for Reefs?

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The above sketch is an idealized conception of the general geologic features.

The Leduc (D3) reef is a medium-sized, dolomitized reef of Upper Devonian age. It is considered to be a transgressive-type reef, and during its life probably resembled a modern Pacific atoll. A shale blanket overlies the reef, and acts as a seal for the oil in the reef reservoir. Immediately above this shale there is another dolomitized Devonian oil-producing zone — the D2 — which is probably biostromal in origin.

The overlying formations are draped over the reef, the amount of draping diminishing rapidly away from the reef. Oil and gas shows have been found above the reef in sandy facies in the Cretaceous formations. The Leduc reef has a maximum thickness of about 700 feet. The highest and most productive part is along the northeast edge, where the oil and gas zone is 230± feet thick.

SSC Recommends the Following Approach for Seismic Reef Exploration.

NO. 2. DETAILED SURFACE AND SUBSURFACE COVERAGE.

The delineation of the anomalous subsurface conditions usually associated with organic reefs requires a close spacing of subsurface depth points. This implies not only a close spacing of geophones, but also a close spacing of closed traverses on the surface. CONTINUOUS PROFILING, originally developed by SSC, is the ONLY procedure that furnishes coverage sufficiently detailed for a successful reef exploration program.

(This is one of a series)

Seismograph Service Corporation

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panies have been interested in the Oriente (Montana) region of Peru, and have conducted some preliminary exploration. In view of the transportation difficulties and high investment cost (estimated at $250,000,000) which would be necessary for development of this region and with large investments already committed elsewhere, these companies have been reluctant to enter into any further operations, at least until a more favorable petroleum law was adopted by Peru. A new petroleum law was drafted toward the end of 1949. The proposed law divides Peru into the following oil regions: (1) Continental Shelf, (2) Coastal, (3) Sierra, and (4) Montana with maximum exploration concessions at 60,000 hectares, 80,000 and 200,000 hectares for the last three regions, respectively. Development concessions are held to one-half of the exploration concession.

Although this is a decree law and has not yet received constitutional approval, Conorada Petroleum Corp. (Continental, Ohio Oil Co., and Amerada) has obtained a permit for exploration in the Sechura Desert. Preliminary gravimetric survey is to be made.

ARGENTINA

Production, bbl. daily	**65,000**
Reserves, bbl.	**300,000,000**
Refineries, No.	**17**
Refining cap., bbl. daily	**151,700**
Population (census 1947)*	**16,107,936**
Area, sq. miles	**1,078,769**
Currency unit	**Peso**
Value	**$0.0745**

ARGENTINA stretches for 2,200 miles from north to south and has a width (maximum) of 900 miles. Climate largely determines the geography of Argentina, with average rainfall decreasing from 30-40 in. annually in the tropical and semitropical northern areas to less than 16 in. over Patagonia. As a result the Argentina Republic consists geographically of: (1) the sparsely settled northern provinces and territories, characterized by heavy forests and savannas; (2) the level pampa or plain some 700 miles in length and 400 miles in width from the Atlantic westward to the 16-in.-rainfall line where the land becomes semiarid, and (3) the southern region of Patagonia consisting of dry, windswept steppes with severe winter climate.

Comodoro Rivadavia, located near the coast in the Chubut territory of Patagonia, is the major producing area of Argentina. Over 70 per cent of Argentina's total production (currently estimated at 65,000 to 66,000 bbl. daily) comes from the Rivadavia. Other Argentine production is derived from the Plaza Huincul and the Mendoza fields located in Neuquen territory and Mendoza province, adjoining Chile and the Andes Mountains. In the extreme north of Argentina production also comes from the Salta region. Argentine reserves are estimated at about 300,000,000 bbl.

Lacking coal resources and with limited hydroelectric power potential, government policy has been to step up petroleum production and the utilization of natural gas. Toward the end of 1949 the world's longest (1,100-mile) 10-in. gas line was completed, with capacity for transmission of 35 M.M.c.f. daily from the Comodoro Rivadavia fields to the Buenos Aires area. This project was carried out by the Direccion General del Gas del Estado (National Gas Administration).

The oil industry has been largely a government monopoly in Argentina since the discovery of Comodoro Rivadavia in 1907. The government company, Y.P.F., produces about 70 per cent of Argentina's oil. Current geological and geophysical surveys and development of oil and gas are being conducted by Y.P.F. In addition to its activities in Plaza Huincul field and other areas, Y.P.F. has also announced the first oil discovery on the Argentine side of the Tierra del Fuego near the port of Rio Grande, although actual production of the discovery well was in small quantity. In 1949 a gas field was discovered in this area.

While pushing development of oil and gas production Y.P.F. has also been concerned with expansion of refining capacity. Total capacity of refineries in the Argentine Republic is some 150,000 bbl. daily of crude throughput, including completed and building capacity increases of Y.P.F. refineries. The government plants account for about two-thirds of this total. Argentina's liquid-fuel imports in 1949 amounted to 3,929,665 metric tons—of which 1,479,267 tons was crude and 2,158,256 tons was fuel oil.

BOLIVIA

Production, bbl. daily	**2,400**
Production, accum., bbl.	**5,176,000**
Reserves, bbl.	**20,000,000**
Refining cap., bbl. daily	**7,200**
Population	**3,854,000**
Area, sq. miles	**416,040**
Currency	**Boliviano**
Value	**$0.0166**

HIGH Andean ranges take up about two-fifth of Bolivia's area, the remainder being tropical plain. Bolivia has no seacoast and is dependent on railroad connections with Peru, Chile, and Argentina, or air transportation.

A concession, acquired in Bolivia by Standard Oil Co. (N. J.) in 1921 was operated until 1937 when the property was taken over by a government company, Yacimientos Petroliferos Fiscales Bolivianos (Y.P.F.B.). Although a law permitting operation of mixed companies has been under consideration by the Bolivian congress, the government-owned Y.P.F.B. is presently the sole operator of the Bolivian oil industry. Prior to transfer of properties, Standard had conducted considerable exploration, drilled 28 exploration wells opening up fields along the eastern slopes of the main Andes ranges, and had constructed two small refineries. Since taking over, Y.P.F.B. operating with limited equipment, has developed the potential of Camiri field in a program integrated with refinery and pipe-line construction.

Camiri's Production

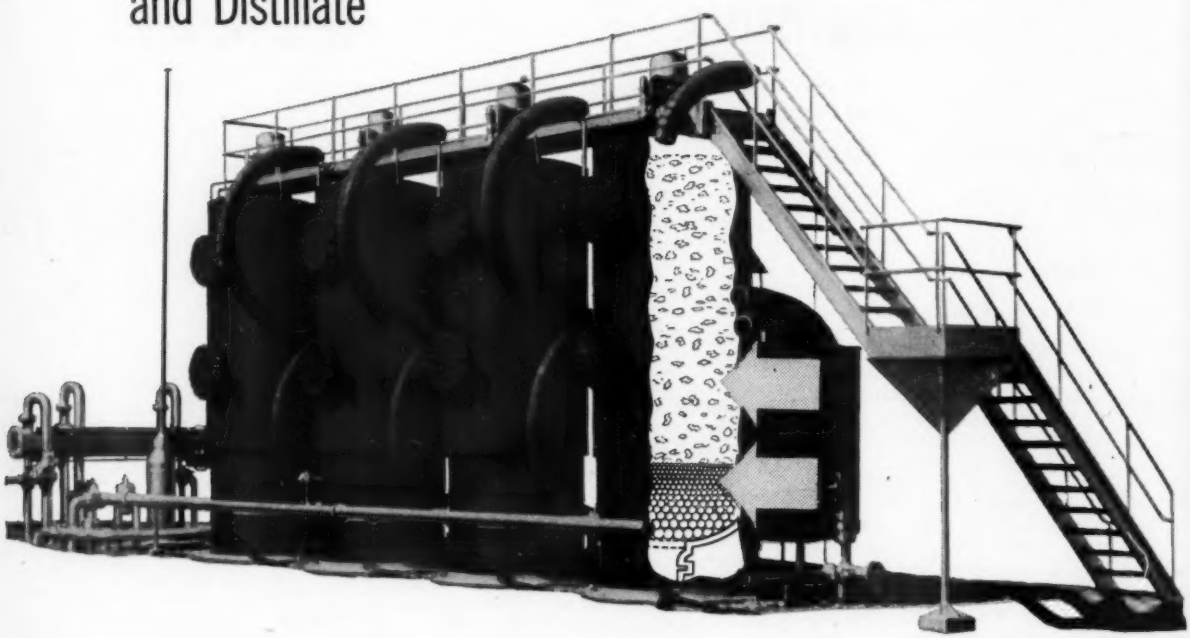
Camiri field provides most of Bolivia's production and accounted for 267,438 bbl. in 1948 and 516,296 bbl. in 1949 with estimated daily average of 1,300 bbl. in 1950. Other producing fields are the Bermejo and Sanandita, each with estimated 1950 production of 400 bbl. daily. Estimated total Bolivian production for 1950 is 2,400 bbl. daily. Drilling activities this year were concentrated in the Camiri and nearby Guairuy field. Other drilling near Camiri was conducted on the Mandeyapecua structure. A wildcat discovery was reported on the Los Monos structure 11 miles north of Sanandita.

The new 5,000-bbl. refinery under construction at Cochabamba was due to go on stream in late 1950. A 1,000-bbl. topping plant was placed in operation at Sucre in 1949 and currently is being expanded by an additional 3,000 bbl. daily. To connect Camiri field (elevation 2,400 ft.) with these refinery outlets a pipe-line system was constructed with 255 miles of 6-in. main line going to Cochabamba at an elevation of 8,400 ft. and a 4-in. branch of 45 miles to Sucre at an elevation of 9,700 ft.

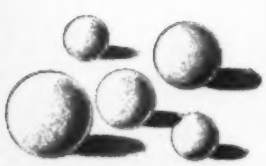
On completion of the current program the major portion of Bolivia's internal demand for petroleum products will have been met. The second and more difficult and costly phase of the Y.P.F.B. program is the discovery and development of oil production for export.

Wyco Pipe Line Company's **Unique Dehydration Unit** Dries Gasoline and Distillate

The Products Pipe Line Department of the Standard Oil Company (Indiana), one of the principal stockholders of Wyco Pipe Line Company, has recently designed and supervised the construction of a dehydration plant located near Casper, Wyoming, on the Wyco pipe line. Designed for either up or down flow, gasoline and distillate enter the towers through wide radii pipe bends, and are alternately dried at a rate approximating 20,000 barrels per day. ALCOA *Activated* Alumina, supported by ALCOA Tabular Alumina Balls, is the desiccant chosen to readily obtain the desired cycle at 500°F. and 80 lbs. pressure.



with **ALCOA** Activated* Alumina supported by **ALCOA** Tabular Alumina Balls



Not only at Wyco, but throughout the petroleum industry, ALCOA *Activated* Alumina has a reputation as a dependable, economical drying agent. Commercially pure, it is one of the few solid adsorbents that does not change its form or properties. It will not swell, soften or disintegrate, is noncorrosive and practically iron-free.

In addition, bed supports and bed covers of ALCOA Tabular Alumina Balls offer higher efficiency—better operation—of drying towers. These high-purity ceramic balls replace fine mesh inside screens. They reduce resistance to stream flow, and are adaptable to any depth of bed support (five sizes of balls to choose from).

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CHILE

Production, bbl. daily	1,500
Producing fields	2
Production, accum., bbl.	321,000
Reserves, bbl.	35,000,000
Population (est. 1947)	5,479,202
Area, sq. miles	286,396
Currency unit	Peso
Value	$0.0170

IN length Chile extends for 2,660 miles, taking up half the west coast of South America, but its average width is only 110 miles. In area it is seventh among the countries of South America. Geographically Chile consists of the Andes Mountains including the high peaks such as the 22,812-ft.-high Mount Aconcagua, central valleys, and coastal ranges. Bulk of the population is concentrated in the great Central Valley (Vale de Chile) which is some 600 miles long and has an average width of 25-30 miles. The northern region of Chile, in which the nitrate beds occur and where there are important copper and other mineral deposits, is arid while the coast and forested mountains of the south lie within the belt subject to severe winter climate.

Cerro Manantiales (Spring Hill) oil field of Chile was discovered in 1945. This producing area is in the north part of the island of Tierra del Fuego across the Strait of Magellan from Punta Arenas. The Chilean Government's Corporacion de Fomento de la Produccion (Corporation for Promotion of Industrial Production), known as "Corfo," has concentrated on development of this area following geological and geophysical work initiated in 1942. Corfo drilled eight wells during 1948, six being oil wells and two gas wells. Wildcats drilled north of Cerro Manantiales were dry holes. In 1949, 12 additional wells were drilled in Cerro Manantiales, resulting in five oil producers, two gas wells, and five dry holes; one wildcat was brought in as a gas-distillate producer to the north of this field.

In the latter part of 1949 Corfo began production from four wells at an average daily rate of 2,000 bbl. For the first half of 1950 production was 320,154 bbl. Production is from the Cretaceous at about 7,500 ft. The Manantiales field reserves are estimated at 30,000,000 bbl. A 42-mile, 8-in. line with capacity of 15,000 bbl. daily was constructed from Cerro Manantiales to storage and tanker-loading facilities at Caleta Clarencia. It is from this point that crude is being shipped to Uruguay under a sales contract concluded in early 1950. Construction is scheduled to start in late 1950 on a crude-oil-stabilization natural-gasoline plant in Manantiales field. Engineering is also in progress on a 10,000-12,000-bbl. refinery to be located at Vina del Mar near Valparaiso. Currently Chile has not operating refineries.

TRINIDAD

Production, bbl. daily	57,000
Production, accum., bbl.	371,130,000
Reserves, bbl.	250,000,000
Refining cap., bbl. daily	107,300
Population	558,610
Area, sq. miles	1,864
Currency	Pound
Value	$2.80¼

THIS British West Indies island is separated from the Venezuela coast by the Gulf of Paria. The major operating company is Trinidad Leaseholds, Ltd., which reported production of 16,800 bbl. daily average from its own fields during 1949 and 26,900 bbl. daily of crude purchased and from joint fields. Current total production of Trinidad is between 56,000 and 57,000 bbl. per day.

Oil fields are concentrated in the southern part of the island. The chief producing field is Forest Reserve and other important fields are Point Fortin, Fyzabad, and Penal. Unusually high formation pressures are encountered in Trinidad drilling operations. In this connection Trinidad Leaseholds has reported development of an oil-base mud to facilitate drilling in certain formations. Discovery of oil during 1950 in the northern portion of Trinidad by United British Oilfields, Ltd., has been reported although it was not certain whether production was in commercial quantity. Trinidad Leaseholds has several new heavy rigs in operation.

The complete refinery at Pointe-a-Pierre, with nominal capacity of 70,000 bbl. daily, is operated by Trinidad Leaseholds, A 30,000-bbl. refinery located at Point Fortin is operated by United British Oilfields for crude distillation and asphalt manufacture. Trinidad Leaseholds has reported plans for modernization of its refinery, including construction of a 15,000-bbl. daily catalytic cracking plant due to be completed in 1952. Crude is to be imported in sufficient quantity to utilize fully the new refinery facilities. The company is also planning to enter petrochemicals manufacture jointly with Universal Oil Products Co.

BRAZIL

Population	47,550,000
Area, sq. miles	3,286,170
Currency unit	Cruzeiro
Value	$0.0550

OCCUPYING nearly one-half of the continent of South America, Brazil's geography is featured by a plateau or highland on the east, the great low northern interior jungle-plain of the Amazon Basin, and a southern interior region consisting in part of plateau but mostly lowland and lying chiefly in the Parana-Paraguay River Basin. Most of Brazil is in the tropics, but the eastern highland with average elevation of 2,500 ft. provides a more equable climate particularly in its central and southern sections.

The central and most heavily populated portion of the plateau comprises the states of Minas Gerais, Rio de Janeiro which includes the capital and Federal District, and Sao Paulo. A significant movement is the opening up of the State of Goias in the interior for settlement by Brazilians, Italian immigrants, and displaced Europeans, with the building of the interior city of Goiania which is spoken of as the possible future capital of Brazil.

Brazil is rich in minerals, as yet largely undeveloped, and appears to have good possibilities for oil. However, petroleum production is quite small, the industry being still in the exploratory phase. The coal resources of Brazil are limited. Hydroelectric power potential is good and has received considerable development but actually provides but 1.6 per cent of the total energy sources and further development faces difficulties due to the vast areal extent of the country. Wood and charcoal account for 80 per cent or more of Brazil's energy consumption as compared with less than 2 per cent for the United States and possibly 12 per cent for the world as a whole.

In 1949 Brazil produced 109,041 bbl. of oil from fields located in the Candeias area of Baia. Daily production in 1950 is estimated at 880 bbl. With cumulative production through 1949 of 638,493 bbl. these fields are operating at a fraction of their potential and it is expected that their production will be boosted since completion of refining facilities near Salvador in the Candeias area. Recoverable reserves in Baia are reported at 20 to 25 millions of bar-

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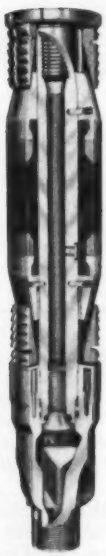

For a "sure-fire" shut-off use this Baker Casing Bridge Plug (Product No. 400-D) which can be run and set either on tubing or a *wire line*. ★ For squeeze cementing, acidizing or testing, use the old reliable Baker Cement Retainer, Product No. 400.

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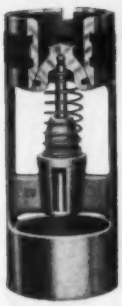
Don't waste time and money hauling kinked Kellys and bent drill pipe to the shop! ★ The Baker Portable Kelly and Pipe Straightener (Product No. 550) does a better job while the Kelly or pipe is suspended vertically through the table; and avoids possible damage in transporting and handling.



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When your casing is equipped with Baker Model "G" Casing Centralizers (Product No. 910-G) you *know* that is REALLY CENTERED with better chances for a "first-time" water shut-off. ★ ★ In directional holes "sled-runner-action" of the springs helps to get pipe to bottom.

No more torn swab rubbers or packing elements. Slips on testers or packers can always contact casing. ★ A Baker ROTO-VERT Casing Scraper (Product No. 620-C) run on drill pipe, or a *wire line*, scrapes casing free from gun-shot burrs and hardened cement.

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rels. Large gas reserves are also reported in the Aratu field.

Until this year, Brazil's refining industry consisted of three small privately owned topping plants with total throughput of 2,000 bbl. per day. The 2,500-bbl. refinery at Mataripe near Salvador designed to operate on local crude went on stream in September. It is planned to enlarge this plant to 5,000 bbl. per day. Start of construction on the 45,000-bbl. refinery at Cubatao near Santos was reported scheduled for late 1950. This refinery is to run on imported (possibly Venezuelan) crude and will make a complete line of fuels. A double products pipe line consisting of 10 and 18-in. line is planned to run from Santos to Sao Paulo. Two other refineries are planned, one at Sao Paulo and the other at Rio de Janeiro, with daily capacities of 20,000 and 10,000 bbl. respectively.

URUGUAY

Refining cap., bbl. daily	**25,200**
Population (est. 1947)	**2,300,000**
Area, sq. miles	**72,172**
Currency	**Peso**
Value	**$0.3775**

THIS smallest, but one of the most progressive, of the South American republics has an equable climate and some of the geographic features both of the Brazilian highlands and the Argentina plain. Uruguay consists chiefly of grassy rolling plain providing good native pasture, and few forests. It is separated from Argentina by the Uruguay River with half of its boundary on the sea and the Rio de la Plata estuary.

About one-quarter of its population is concentrated in the Montevideo area, which is the location (at La Teja) of the refinery operated by the Administracion Nacional de Combustibles (ANCAP). Rated capacity of this refinery has been 15,700 bbl. per day consisting of a topping unit of 6,300 bbl. per day and cracking unit converted for atmospheric distillation of crude. A second crude distillation unit of 9,500-bbl. per day capacity was scheduled for operation in 1950. This includes a vacuum column for processing of 50 per cent topped low-gravity crude to provide 750 bbl. per day of asphalt and including side cuts for lube-oil base stocks.

Uruguayan imports of crude in 1948 totaled 5,427,256 bbl., most of which was listed as "intermediate" crude from Oficina and Jusepin fields of Venezuela and from Arabia. Additional light crude came from Ecuador and Peru and a smaller amount of heavy Temblador crude from Venezuela. In 1950 a contract was signed for delivery of 1,130,000 bbl. of Chilean crude over a period of 18 months.

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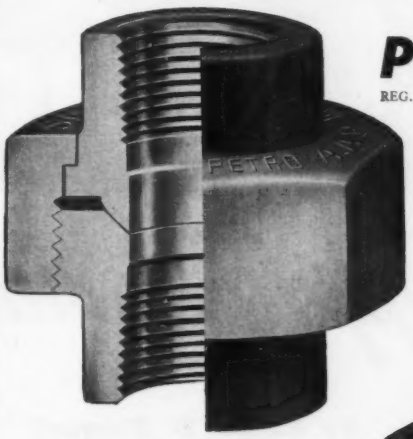

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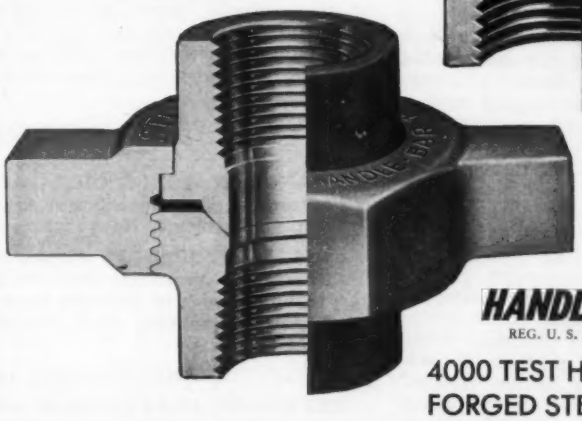

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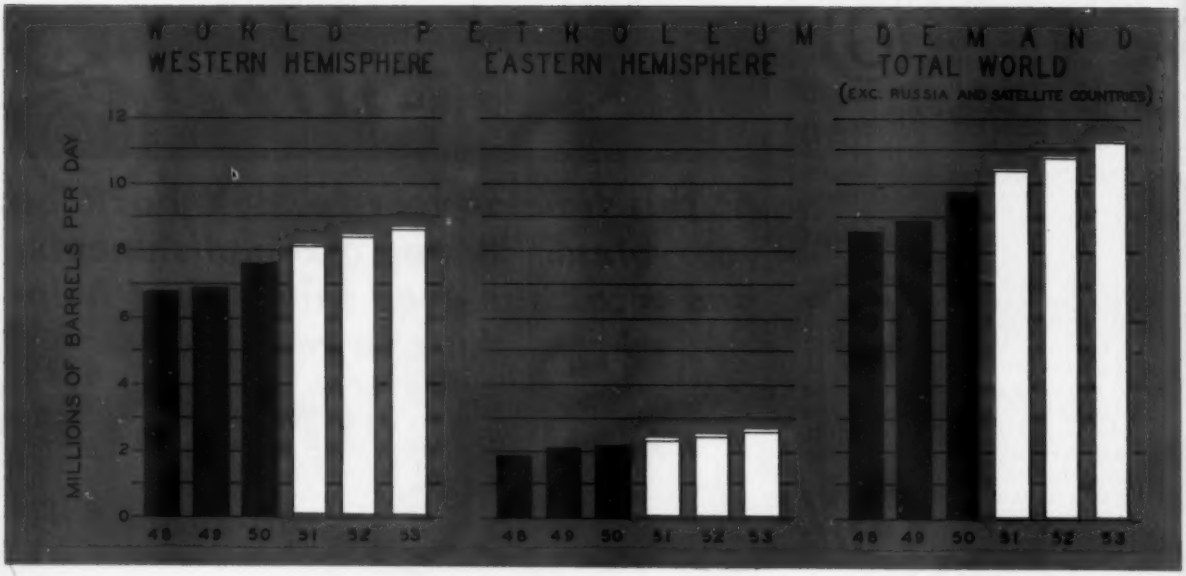


World Supply-Demand Situation

by Arthur D. Stewart*

ABOUT this time a year ago, the world outlook for the petroleum industry was generally discouraging. The industry was threatened with a number of serious problems. First, current demand for petroleum products was below expectations, causing considerable imbalance between supply and demand. Cutbacks in crude-oil production were made here and abroad. During the intervening 12 months, United States oil companies have been threatened with a substantial loss of their overseas markets.

To conserve dollars, foreign governments have restricted the importation of "dollar oil" through exchange and import regulations and by a policy of substituting "sterling oil" for dollar oil. Furthermore, American oil companies have been adversely affected by bilateral trade agreements that tended to eliminate dollar oil in a number of markets abroad. The outlook became further clouded by known plans of British companies for exceedingly large expansion of their crude-oil production and refining facilities over and above their requirements. As more and more sterling oil became available dollar oil has been replaced in order to conserve gold and dollar reserves. Not only has the door been closed abroad to dollar oil but there has been a very strong demand to shut out foreign oil from entering the United States.

Legislative action has been demanded to reduce or limit oil imports (largely produced by United States oil companies) entering the United States. This has been a serious and difficult problem to combat in view of the cutbacks made in domestic production of both oil and coal. The petroleum industry has been also beset by a number of congressional committees investigating the activities of oil companies in connection with proposed bills pertaining to regulating imports and divorcement of integrated companies. All in all the outlook for the petroleum industry, both foreign and domestic, has been generally discouraging.

However, today some of these problems have been temporarily resolved, in whole or in part, due to a large extent to the efforts made by the

*Economist, Foreign Trade Department, Socony-Vacuum Oil Co., Inc.

HIGHLIGHTS

CHANGE IN WORLD OUTLOOK.—A year or so ago the outlook was generally discouraging and the industry was confronted with many serious problems. Now—future prospects viewed with more optimism.

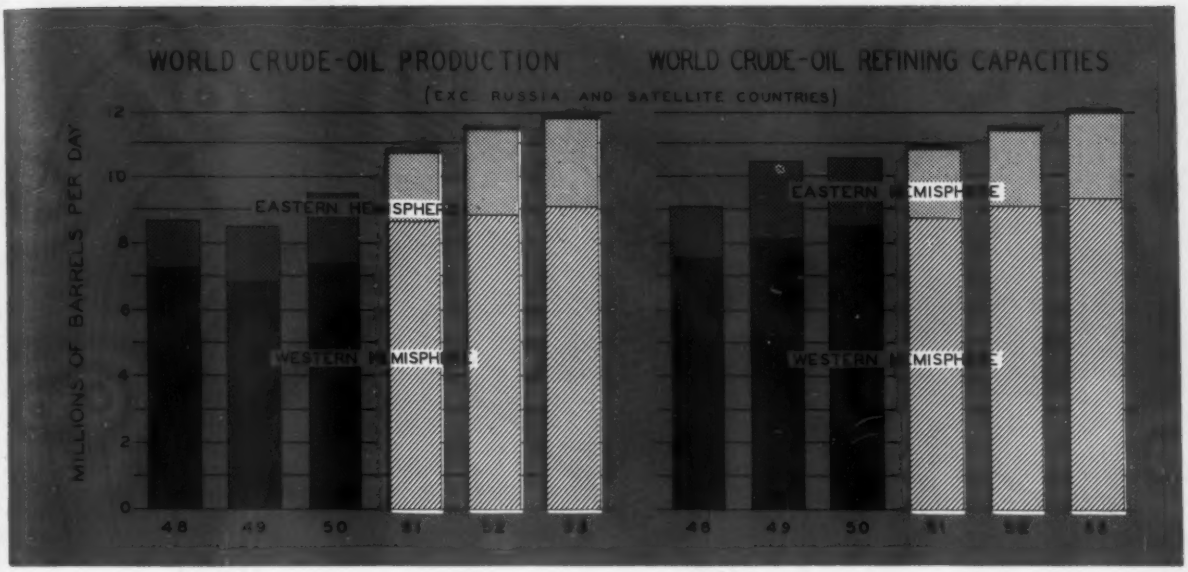
FOREIGN-CURRENCY SITUATION.—Generally improved. United States oil companies nevertheless confronted with serious problem of accepting and utilizing nondollar currencies, due to foreign governments reducing their United States dollar allocations for crude and products.

WORLD DEMAND.—Forecasts revised upward for ensuing 3 years.

EXPANSION PLANS.—World crude producibility and refining capacity indicate sufficient available supplies to meet growing world demand for next 3 years.

PETROLEUM MOVEMENTS.—Decline in flow of petroleum from Western to Eastern Hemisphere. Rise in flow from Eastern to Western Hemisphere. Western Hemisphere expected to become net importer.

MAINTAINING BALANCE.—No world overexpansion of crude producibility and refining facilities now foreseen. Crude producibility and refining capacity versus demand indicate margin of only 10 per cent. This, however, may be too low a margin of safety in view of extensive economic and military mobilization program for world security.



...Now Viewed With More Optimism

petroleum industry in meeting and solving these problems. To relieve the demand for dollars, most oil companies hope to work out ways and means to accept and use some sterling and other nondollar currencies in their overseas operations. In this connection, while the dollar position has been improved in many countries abroad, due in part to continued ECA dollar aid, nevertheless a number of foreign countries are endeavoring to reduce their United States dollar allocations for crude and products.

Problem of Foreign Currency

Domestic companies, therefore, continue to be confronted with the serious problem of working out ways and means of accepting and utilizing foreign currencies in place of United States dollars. If this problem is not resolved satisfactorily, oil will not flow freely in world trade. It is also a credit to the industry that acting individually many American oil companies voluntarily restricted their imports into the United States in order to relieve the domestic supply situation. Therefore, due in a large measure to their policy of "help themselves," the world outlook today for the petroleum industry has improved generally over that of a year or more ago.

The rearmament program both in this country and in western Europe set in motion by the Korean conflict in June has brought further changes in the outlook. Many of the old problems are expected to disappear or be relegated to the background. However, the new preparedness program is expected to bring about a whole new set of problems no less formidable perhaps than those confronting the industry about this time a year ago. Probably the most serious and difficult problem confronting the industry is how to be adequately prepared to produce sufficient supplies of specialized products needed by the military in a sudden and total war.

World refining, storage, and transportation facilities appear to be adequate to take care of the requirements of a peacetime economy. The increases in these facilities during the next few years will probably maintain this same relative position. However, the industry may encounter difficulty in meeting the demands for extraordinarily large quantities of high-octane gasoline and special jet fuels which would be required for a total war.

However, going beyond the problems attendant to war preparedness, it is believed that the petroleum industry is entering an era of improved economic stability generally and better-than-moderate expansion in both United States and in most countries abroad.

The forecasts of supply and demand as presented in this article have been predicated for the most part on the improved general outlook including the following basic assumptions:

1. High level of industrial activity in the United States and in western Europe.

2. Continuation of military activity on the assumption that the termination of the Korean conflict will be offset by increased defense activities.

3. No World War III expected within the next 3 years.

4. No rationing in the use of petroleum products in the United States or in countries abroad.

5. Currency matters affecting United States oil companies resolved satisfactorily.

6. Rearmament program is expected to stimulate and not retard the demand for petroleum products throughout the world.

7. No economic recession or depression is expected in this country or abroad during the next 3 years.

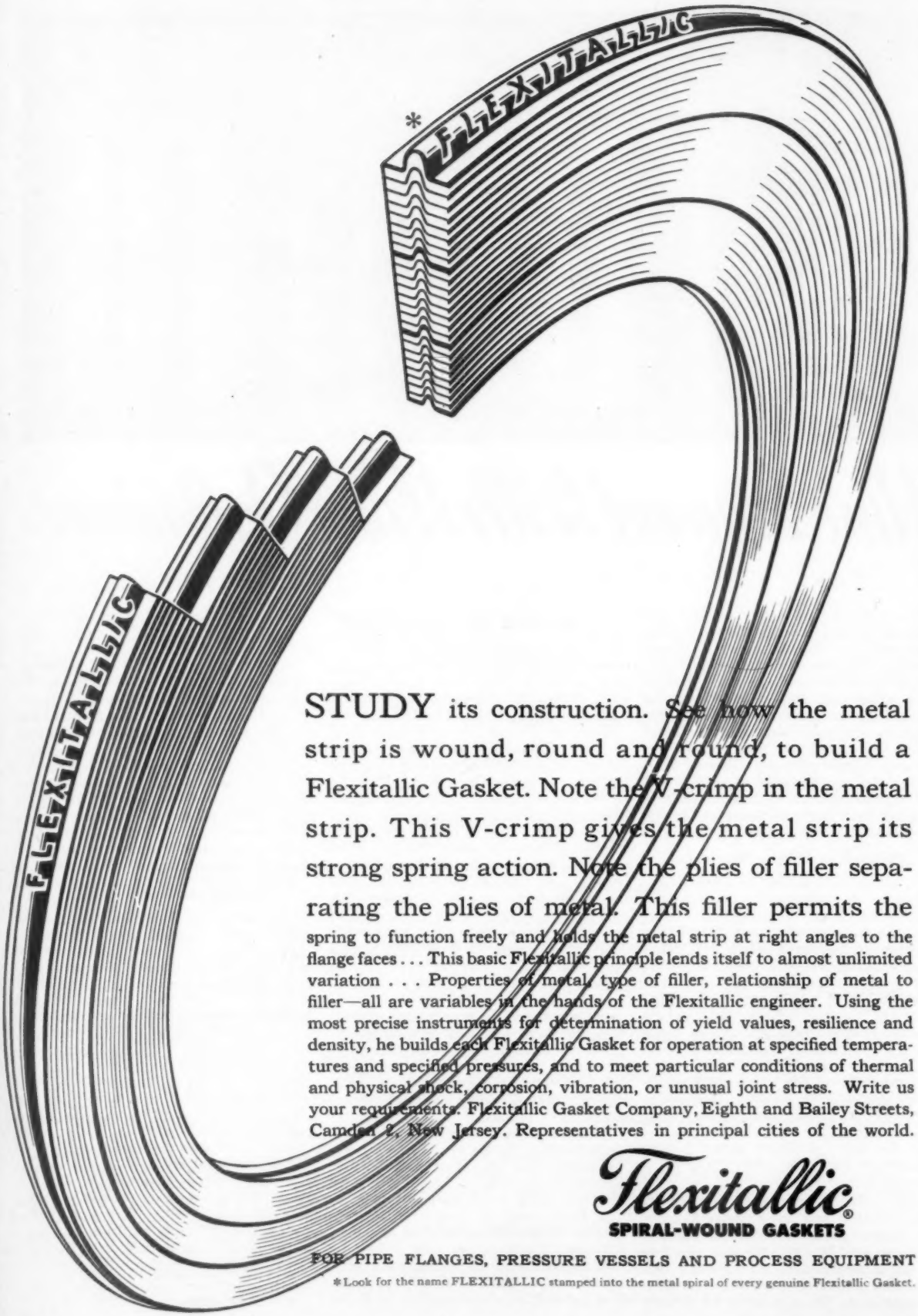
Outlook for World Demand

According to reports available to date, world demand for oil (excluding U.S.S.R. and satellite countries) will very likely reach or exceed the unprecedented daily average of 9,866,-

TABLE 1—WORLD DEMAND—EXCLUDING U.S.S.R. AND SATELLITE COUNTRIES
(Thousands of barrels daily)

		Increase versus previous year	
Actual—	Barrels	Barrels	Per cent
1938	4,886	....	....
1946	7,146	....	....
1947	8,052	906	12.7
1948	8,636	584	7.3
1949	8,945	309	3.6
1950*	9,866	921	10.3
Outlook—			
1951	10,404	538	5.5
1952	10,871	467	4.5
1953	11,261	390	3.6

*Partly estimated.



STUDY its construction. See how the metal strip is wound, round and round, to build a Flexitallic Gasket. Note the V-crimp in the metal strip. This V-crimp gives the metal strip its strong spring action. Note the plies of filler separating the plies of metal. This filler permits the spring to function freely and holds the metal strip at right angles to the flange faces . . . This basic Flexitallic principle lends itself to almost unlimited variation . . . Properties of metal, type of filler, relationship of metal to filler—all are variables in the hands of the Flexitallic engineer. Using the most precise instruments for determination of yield values, resilience and density, he builds each Flexitallic Gasket for operation at specified temperatures and specified pressures, and to meet particular conditions of thermal and physical shock, corrosion, vibration, or unusual joint stress. Write us your requirements. Flexitallic Gasket Company, Eighth and Bailey Streets, Camden 2, New Jersey. Representatives in principal cities of the world.

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TABLE 2—DOMESTIC DEMAND* FOR CRUDE AND PRODUCTS IN UNITED STATES
(Thousands of barrels daily)

Actual—	Barrels	Increase versus previous year: Barrels	Per cent
1938	3,115	...	...
1946	4,912	...	...
1947	5,452	540	11.0
1948	5,775	323	5.9
1949	5,792	17	.3
1950†	6,464	672	11.6
Outlook—			
1951	6,772	308	4.8
1952	7,014	242	3.6
1953	7,191	177	2.5

*U. S. exports not included. †Partly estimated.

000 bbl. for the year just closing. Table 1 points up that over a period of 12 years, world demand has doubled notwithstanding that there was a world war for 6 years during this period.

World demand as presently foreseen will continue to rise during the next 3 years, exceeding the 10-million-barrel per day mark in the coming year. The petroleum industry should plan to provide producing, refining, and transportation facilities to meet an average increase in world demand of about 0.5 million barrels daily over the preceding year, or an increase of 5 per cent per annum.

Outlook for Demand in the United States

Domestic demand for crude and products in the United States is expected to reach a high level of 6,464,000 bbl. daily for the year 1950, an increase of 672,000 bbl. daily or 11.6 per cent over the year 1949. This is the largest volumetric gain in any single year in the history of the industry—also the largest increase percentagewise since World War II. The year 1950 has been one with changing outlook for demand. The upturn generally in United States economy followed by the stimulus of the new rearmament program brought about a more favorable outlook for demand.

Several times during the year economists raised their sights as to the probable total demand for the year 1950. Market-research analysts now foresee continuing larger demand for oil in the United States during the coming 3 years. Their outlook for demand as indicated by the figures in Table 2 reflects a substantial upward revision of earlier forecasts prepared prior to the outbreak of the Korean conflict.

During each of the last 3 years, there has been a substantial rise in the demand for gasoline in the United States. Table 3 indicates a continued upward trend for the next 3 years in the demand for this product in accordance with the following factors:

1. Continued rise in motor vehicle registrations from 48⅓ million at the end of 1949 to an estimated 54 million at the end of 1953.
2. Increasing use of and demand for petroleum products by the agricultural industry.
3. Growth in population and number of families.
4. Increase in the number of people with incomes sufficient to afford ownership of motor cars.
5. Movement of families from cities to suburban areas.
6. Continued high level of industrial activity.
7. No rationing of gasoline for civilian motor-car use.

Percentagewise United States domestic demand for distillates will show very likely the largest increase as compared with other products. Continued upward trend in demand for distillates as now foreseen for the next 3 years is attributed primarily by market research analysts to the following factors:

1. Continuing consumer demand for automatic heat.
2. Growing number of diesel locomotives.

Over the next 3 years the consumption of residual fuel oil according to Table 3 is not expected to exceed the 1950 level and may fall off to a minor extent due largely to the following factors:

1. Supply situation. Although more crude will be run by United States refineries the relative yield of residuals is expected to be less due to more cracking for the lighter fractions. Although imports of residual oils are expected to increase, such supplies are not unlimited. Increased imports may only offset the decline in United States domestic supplies.
2. Reconversions back to the use of

TABLE 4—UNITED STATES DOMESTIC DEMAND FOR PETROLEUM PRODUCTS
(Thousands of barrels daily)

Product—	1948 (bbl.)	1953 (bbl.)	Inc. over 5-yr. period: Bbl.	%
Gasoline (incl. avgas)	2,380	3,146	766	32.2
Kerosine	306	332	26	8.5
Distillates	931	1,335	404	43.4
Residuals	1,368	1,455	87	6.4
Lubricants	98	119	21	21.4
All other products	616	764	148	24.0
Total products	5,699	7,151	1,452	25.5
Crude as such and loss	76	40		
Total crude and products	5,775	7,191		

TABLE 3—UNITED STATES DOMESTIC DEMAND‡ FOR PETROLEUM PRODUCTS
(Thousands of barrels daily)

Actual Product Demand

	1947 (bbl.)	1948 Bbl.	1948 Change vs. '47 Bbl.	1948 Change vs. '47 Per cent	1949 Bbl.	1949 Change vs. '48 Bbl.	1949 Change vs. '48 Per cent	1950† Bbl.	1950† Change vs. '49 Bbl.	1950† Change vs. '49 Per cent
Motor gasoline (including avgas)	2,178	2,380	202	9.3	2,501	121	5.1	2,718	217	8.7
Kerosine	281	306	25	8.9	281	*25	*8.2	325	44	15.7
Distillates	817	931	114	14.0	899	*32	*3.4	1,090	191	21.2
Residuals	1,421	1,368	*53	*3.7	1,357	*11	*0.8	1,500	143	10.5
Lubricants	100	98	*2	*2.0	94	*4	*4.1	109	15	16.0
All other products	575	616	41	7.1	624	8	1.3	682	58	9.3
Total products	5,372	5,699	327	6.1	5,756	57	1.0	6,424	668	11.6
Crude as such and loss	80	76			36			40		
Total crude and products	5,452	5,775			5,792			6,464		

Outlook for Product Demand

	1951 Bbl.	1951 Change vs. '50 Bbl.	1951 Change vs. '50 Per cent	1952 Bbl.	1952 Change vs. '51 Bbl.	1952 Change vs. '51 Per cent	1953 Bbl.	1953 Change vs. '52 Bbl.	1953 Change vs. '52 Per cent
Motor gasoline (including avgas)	2,881	163	6.0	3,025	144	5.0	3,146	121	4.0
Kerosine	332	7	2.2	332	...	...	332	...	...
Distillates	1,188	98	9.0	1,271	83	7.0	1,335	64	5.0
Residuals	1,500	...	...	1,485	*15	*1.0	1,455	*30	*2.0
Lubricants	114	5	4.6	117	3	2.6	119	2	1.7
All other products	717	35	5.1	744	27	3.8	764	20	2.7
Total products	6,732	308	4.8	6,974	242	3.6	7,151	177	2.5
Crude as such and loss	40			40			40		
Total crude and products	6,772			7,014			7,191		

*Decrease. †Partly estimated. ‡Exports not included

coal by a number of public-utility and industrial plants due to the reduction of price differential of oil versus coal.

3. Increasing use of natural gas.

Most of the increase in the demand for lubricants is for industrial uses. Although the number of motor vehicles in use will increase, the demand for motor-lubricating oil is not expected to grow at a corresponding rate due to the declining ratio of fuel consumption to lubricating-oil consumption.

Table 4 is presented to facilitate a comparison of the rate of growth in United States domestic demand for each product over the 5-year period, 1948-1953.

From Table 4 it is to be observed that the largest increases both volume and percentagewise are indicated for gasoline and distillates. Over the 5-year period a relatively small increase is expected in domestic consumption of residuals.

Outlook for Demand in Foreign Countries

According to all available data received to date, total demand for crude and products outside the United States (excluding U.S.S.R. and satellites) will reach the high level of 3.4 million barrels daily in 1950, an increase of ¼ million barrels per day over 1949, or 8 per cent. Table 5 indicates that total foreign demand over the past 12 years has almost doubled despite the fact that half the period included World War II.

The outlook for total foreign demand for crude and products during the ensuing 3 years is expected to rise at an average annual increment exceeding 200,000 bbl. daily or between 6 and 7 per cent. During this 3-year period total foreign demand will for the first time exceed 4 million barrels daily.

In view of the fact that there is not yet available statistical evidence on which to evaluate the probable effect of the rearmament program abroad, the outlook for foreign demand as presented here has been predicated largely on current trends taking into consideration the following factors:

1. Continued upward rise in industrial production.
2. Continued economic improvement and better political stability.
3. Termination of rationing of petroleum products.
4. Increased mechanization of agriculture.
5. Increased use of oil-burning equipment.
6. Continued upward trend in motor-vehicle registrations.
7. Improvement of present highway systems and new road-building programs.
8. Large dollar and gold reserves accumulated abroad during 1950.
9. Arrangements whereby United States oil companies can accept and use sterling and other nondollar currencies.
10. Favorable effects of the European Payments Union.
11. Rearmament program abroad is not expected to retard demand for oil.

It is to be noted, however, from Table 5 that the rate of growth during the 3 years (1951-53) is not expected to be as great as the preceding postwar years (1946-50). The demand for petroleum products during the earlier years after World War II reflects reconstruction, rehabilitation, large conversion from coal to oil and a substantial replacement of stocks.

The largest oil-consuming markets in the world outside of the United States are located in the Marshall-plan countries (OEEC) of western Europe which consumes about one-third of total foreign consumption (see Table 6). The growth in demand for petroleum products in these countries is expected to continue at a higher rate as compared with other foreign areas. This points up the remarkable postwar economic recovery in western Europe due chiefly to the Marshall-plan aid. Western Europe has passed the reconstruction and rehabilitation phase of postwar recovery and has entered an era of developing new patterns of European trade and exchange to make better use of Europe's resources which in

TABLE 5—FOREIGN DEMAND* FOR CRUDE AND PRODUCTS
(Excl. U.S.S.R. and Satellite Countries)
(Thousands of barrels daily)

		Increase versus previous year	
Actual—	Barrels	Barrels	Per cent
1938	1,771	....	....
1946	2,234	....	....
1947	2,600	366	16.4
1948	2,861	261	10.0
1949	3,153	292	10.2
1950†	3,402	249	7.9
Outlook—			
1951	3,632	230	6.8
1952	3,857	225	6.2
1953	4,070	213	5.5

*Exports not included. †Partly estimated.

TABLE 7—DEMAND FOR CRUDE AND PRODUCTS: SUMMARY
(Thousands of barrels daily)

Western Hemisphere (Excl. United States)

Years—	Total demand	Average yearly incremental quantity	Average yearly per cent increase
1947	968	...	...
1950*	1,207	80	8.3
1953	1,431	75	6.2

Eastern Hemisphere (Excl. U.S.S.R. and Satellites)

1947	1,632	...	...
1950*	2,195	188	11.5
1953	2,639	148	6.7

*Partly estimated.

TABLE 6—WORLD PETROLEUM DEMAND
(Excluding U.S.S.R. and Satellite Countries)
(Thousands of barrels daily)

	Actual demand						Outlook for demand					
	1948		1949		1950*		1951		1952		1953	
Domestic demand by areas—	1947 (bbl.)	Bbl.	% inc. vs. '47	Bbl.	% inc. vs. '48	Bbl.	% inc. vs. '49	Bbl.	% inc. vs. '50	Bbl.	% inc. vs. '51	Bbl.	% inc. vs. '52
United States	5,452	5,775	6	5,792	..	6,464	12	6,772	5	7,014	4	7,191	3
Other North America	460	497	8	536	8	575	7	614	7	650	6	681	5
Caribbean	255	280	10	305	9	327	7	349	7	370	6	389	5
Other South America	253	276	9	285	3	305	7	323	6	341	6	361	6
Total Western Hemisphere	6,420	6,828	6	6,918	1	7,671	11	8,058	5	8,375	4	8,622	3
OEEC countries—Europe	799	878	10	993	13	1,106	11	1,195	8	1,288	8	1,380	7
Other Eastern Hemisphere—west of Suez	214	228	7	258	13	278	8	298	7	315	6	328	4
Total Eastern Hemisphere—west of Suez	1,013	1,106	9	1,251	6	1,384	11	1,493	8	1,603	7	1,708	7
Middle East	264	290	10	306	6	315	3	321	2	329	2	331	1
Far East, South and East Africa and Oceania	355	412	16	470	14	496	6	532	7	564	6	600	6
Total east of Suez	619	702	13	776	11	811	5	853	5	893	5	931	4
Total Eastern Hemisphere	1,632	1,808	11	2,027	12	2,195	8	2,346	7	2,496	6	2,639	6
Total foreign	2,600	2,861	10	3,153	10	3,402	8	3,632	7	3,857	6	4,070	6
Total world	8,052	8,636	7	8,945	4	9,866	10	10,404	5	10,871	4	11,261	4

*Partly estimated.

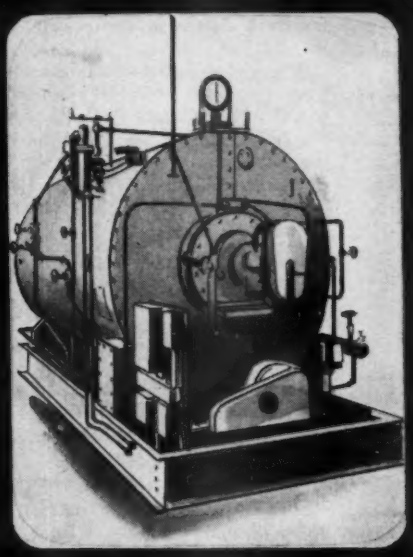

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Table 6 also indicates that the demand for petroleum products in the countries located east of Suez will rise very likely at a lower annual rate as compared with other areas outside the United States due largely to unsettled conditions in several countries in that part of the world.

The demand for crude and products summarized according to the Western Hemisphere and the Eastern Hemisphere, Table 7, indicates that a larger demand will continue in the latter hemisphere.

The petroleum industry must provide for an average annual incremental growth of about 150,000 bbl. daily in the Eastern Hemisphere as compared with only about one-half as much, or 75,000 bbl. daily for the Western Hemisphere (excluding United States) during the ensuing 3 years. It should be noted that whereas in 1947 demand in the Eastern Hemisphere exceeded the Western Hemisphere by 664,000 bbl. daily, in 1953 the differential will rise to over 1.2 million barrels daily.

Table 8 is presented to facilitate a comparison of the rate of growth in foreign demand for each refined product over a 5-year period.

Table 8 indicates that the largest growth volumewise is expected for residuals reflecting increasing use of this product in both industry, including petroleum refineries, and transportation. The market demand for residuals depends upon many factors among which are the following:

1. Coal production.

2. Bilateral trade agreements between coal-producing countries and coal-importing countries.

3. Development of hydroelectric plants.

4. Governmental control in some countries of the consumption of coal and fuel oil.

5. Comparative B.t.u. cost to consumer—coal versus oil.

It is to be observed from Table 8 that percentagewise motor fuel and distillates show a larger gain as compared with residuals. In this connection, the greater part of the market demand in foreign countries before the war was for the light oils. During the immediate postwar years the demand for residuals rose sharply due largely to the shortage of coal. However, it now appears there may be a reverting back to the prewar pattern of product market demand abroad as evidenced by the higher percentage growth for gasoline and distillates. This also seems to be borne out from the data given in Table 9 indicating that for the years 1947-49 inclusive a greater growth percentagewise for residuals but beginning with the year 1950 a falling off is to be noted in the percentage gain to a rate below that indicated for gasoline and distillates. This trend towards a faster growth in demand for light oils is supported by the following:

1. Large-scale postwar conversions from coal to residual fuel was for the most part completed in 1949.

2. Termination of gasoline rationing abroad during 1950 especially in the United Kingdom, its colonial possessions, and Commonwealth countries.

3. Increased mechanization of agriculture utilizing diesel and gasoline-powered equipment.

4. Sharp increases in motor-vehicle registrations especially commercial vehicles, both gasoline and diesel powered.

5. Greater use of industrial and marine diesel engines due to economy and efficiency in operation.

6. Current and anticipated future displacement of many steam locomotives by diesel locomotives.

It should be noted that over the 5-year period (1948-53 inclusive) the increase in demand for kerosine is expected to amount to only 48,000 bbl. daily, or 24.6 per cent, a percentage rate of growth lower than any other product. The slow growth in demand for kerosine is due primarily to greater use of electricity and possibly the displacement of kerosine by other products. The decline in kerosine consumption is largely confined to the more advanced industrialized countries of western Europe. A continued upward demand for kerosine is expected in countries which are predominantly agricultural

TABLE 8—TOTAL FOREIGN REFINED PRODUCT DEMAND
(Excluding U.S.S.R. and Satellites)
(Thousands of barrels daily)

1953 Versus 1948

	1948 (bbl.)	1953 (bbl.)	Inc. Bbl.	Inc. %
Motor fuel, (incl. avgas)	769	1,153	384	49.9
Kerosine	195	243	48	24.6
Distillates	482	705	223	46.3
Residuals	1,222	1,709	487	39.9
Lubes	64	87	23	35.9
All other products	80	113	33	41.3
Total products	2,812	4,010	1,198	42.6
Crude as such and loss	49	60		
Total crude and products	2,861	4,070		

TABLE 9—FOREIGN DEMAND* FOR PETROLEUM PRODUCTS
(Excluding U.S.S.R. and Satellite Countries)
(Thousands of barrels daily)

Actual Product Demand

	1947	1948	Change vs. '47		1949	Change vs. '48		1950†	Change vs. '49	
	(bbl.)	Bbl.	Bbl.	Per cent	Bbl.	Bbl.	Per cent	Bbl.	Bbl.	Per cent
Motor gasoline (including avgas)	714	769	55	7.7	851	82	10.7	936	85	10.0
Kerosine	188	195	7	3.7	210	15	7.7	219	9	4.3
Distillates	443	482	39	8.8	520	38	7.9	578	58	11.2
Residuals	1,077	1,222	145	13.5	1,365	143	11.7	1,445	80	5.9
Lubricants	60	64	4	6.7	68	4	6.3	73	5	7.4
All other products	74	80	6	8.1	87	7	8.8	97	10	11.5
Total products	2,556	2,812	256	10.0	3,101	289	10.3	3,348	247	8.0
Crude as such and loss	44	49			52			54		
Total crude and products	2,600	2,861			3,153			3,402		

Outlook for Product Demand

	1951	Change vs. '50		1952	Change vs. '51		1953	Change vs. '52	
	Bbl.	Bbl.	Per cent	Bbl.	Bbl.	Per cent	Bbl.	Bbl.	Per cent
Motor gasoline (including avgas)	1,014	78	8.3	1,086	72	7.1	1,153	67	6.2
Kerosine	228	9	4.1	235	7	3.1	243	8	3.4
Distillates	620	42	7.3	663	43	6.9	705	42	6.3
Residuals	1,534	89	6.2	1,623	89	5.8	1,709	86	5.3
Lubricants	80	7	9.6	84	4	5.0	87	3	3.6
All other products	100	3	3.1	105	5	5.0	113	8	7.6
Total products	3,576	228	6.8	3,796	220	6.2	4,010	214	5.6
Crude as such and loss	56			61			60		
Total crude and products	3,632			3,857			4,070		

*Exports not included. †Partly estimated.

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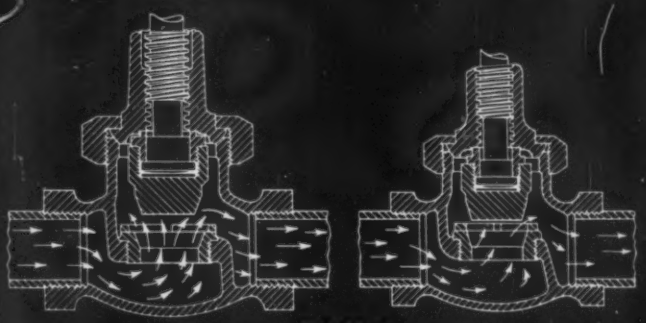

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Outlook for World Supply

Available reports (excluding U.S.S.R. and satellite countries) indicate that world crude oil and allied-products production will reach very likely the high level of nearly 10 million barrels daily for the year 1950, a gain of almost 1 million barrels or 11 per cent over the previous year.

World supply of raw materials tends to follow world crude and products demand. In this connection, we have already observed that world demand over a 12-year period from 1938 has about doubled—and it is to be noted that a corresponding rise has taken place in the world supply of raw materials.

Geologists and petroleum engineers foresee continued upward growth of world crude availability as indicated in Table 10.

World availability of raw materials seems to be growing in the neighborhood of 5 per cent per annum or about the same rate of increase indicated for world demand.

A historical record of production over the past 3 years and the outlook for crude availability broken down according to geographical areas is presented in Table 11. One of the outstanding points to be observed from this table is the growth in actual production abroad particularly the Middle East. In all areas including the United States the outlook is for continued larger available supplies in each of the coming 3 years.

During the past few years considerable attention was given to the significance of the development of crude-oil production from large reserves located in Middle East countries. It now appears that during the coming years more and more attention will be focused upon the significance of the development of large reserves located in Alberta, Canada.

Table 12 shows that actual production of crude and allied products followed closely demand for crude and products with the exception of the years 1947 and 1948.

For 1947, as it is well known, demand exceeded available supplies and stocks were heavily drawn upon. During the year 1948 an endeavor was made to replenish supplies and production ran far ahead of current rate of demand indicating that excess production was needed for stock replenishment.

TABLE 10—WORLD SUPPLY‡—CRUDE OIL AND ALLIED PRODUCTS PRODUCTION
(Excluding U.S.S.R. and Satellites)
(Thousands of barrels daily)

Actual—	Actual prod. (bbl.)	Producibility§ (bbl.)	Inc. versus prev. year Bbl.	%
1938	4,996	....	....	....
1946	7,346	....	....	....
1947	8,046	....	700	9.5
1948	9,095	....	1,049	13.0
1949	9,007	....	*88	*1.0
1950†	9,995	....	988	11.0
Outlook—				
1951	....	11,443	....	....
1952	....	12,039	596	5.2
1953	....	12,545	506	4.2

*Decrease. †Partly estimated. ‡Crude-oil supplies, including natural gasoline, benzene, etc. §Crude producibility for the years 1951, 1952, and 1953 means generally the expected maximum efficient rate (MER) of production as based on the judgment of operating managers incorporating geological and engineering estimates. For several producing areas abroad, the MER production has been predicated on known programed facilities or producing schedules that have been geared to anticipated outlets.

TABLE 12—WORLD SUPPLY VS. WORLD DEMAND
(Excluding U.S.S.R. and Satellite Countries)
(Thousands of barrels daily)

Actual—	Actual prod.‡ (bbl.)	Demand for crude and products (bbl.)	Excess supply—Demand related to actual prod. Bbl.	%
1938	4,996	4,886	110	2.2
1946	7,346	7,146	200	2.7
1947	8,046	8,052	*6	..
1948	9,095	8,636	459	5.0
1949	9,007	8,945	62	0.7
1950†	9,995	9,866	129	1.3

Outlook—	Producibility		Demand related to producibility Bbl.	%
1951	11,443	10,404	1,039	9.1
1952	12,039	10,871	1,168	9.7
1953	12,545	11,261	1,284	10.2

*Deficiency of supply. †Partly estimated. ‡Crude-oil supplies including natural gasoline, benzene, etc.

TABLE 11—WORLD SUPPLY—PETROLEUM CRUDE OIL AND ALLIED PRODUCTS PRODUCTION
(Excluding U.S.S.R. and Satellite Countries)
(Thousands of barrels daily)

	Actual production							Outlook—availability of supply (producibility)				
		1948		1949		1950		1951	1952		1953	
Crude oil: Domestic supply by areas—	1947 (bbl.)	Bbl.	% inc. vs. '47	Bbl.	% inc. vs. '48	Bbl.	% inc. vs. '49	Bbl.	Bbl.	% inc. vs. '51	Bbl.	% inc. vs. '52
United States	5,088	5,520	8	5,042	†8	5,369	6	6,405	6,517	2	6,637	2
Other North America	176	193	10	226	17	263	16	447	491	10	559	14
Caribbean	1,315	1,459	11	1,459	..	1,646	13	1,706	1,734	2	1,733	..
Other South America	102	110	8	115	5	115	..	123	125	2	124	..
Total Western Hemisphere	6,681	7,282	9	6,842	†6	7,393	8	8,681	8,867	2	9,053	2
OEEC countries—Europe	34	42	24	47	12	64	36	65	72	11	77	8
Other Eastern Hemisphere—west of Suez	26	36	38	44	22	48	9	47	69	47	70	1
Total Eastern Hemisphere—west of Suez	60	78	30	91	17	112	23	112	141	26	147	4
Middle East	837	1,141	36	1,400	23	1,739	24	1,843	2,148	17	2,398	12
Far East and Oceania	69	154	123	206	34	230	12	243	288	19	335	16
Total east of Suez	906	1,295	43	1,606	24	1,969	23	2,086	2,436	17	2,733	12
Total Eastern Hemisphere	966	1,373	42	1,697	24	2,081	23	2,198	2,577	17	2,880	12
Total foreign	2,559	3,135	23	3,497	12	4,105	17	4,474	4,927	10	5,296	7
Total world	7,647	8,655	13	8,539	†1	9,474	11	10,879	11,444	5	11,933	4
Natural gasoline, benzene, etc.:												
United States	364	402	10	428	6	477	11	514	542	5	557	3
Foreign	35	38	9	40	5	44	10	50	53	6	55	4
Total world	399	440	10	468	6	521	11	564	595	5	612	3
World supply—raw materials:												
United States	5,452	5,922	9	5,470	†8	5,846	7	6,919	7,059	2	7,194	2
Foreign	2,594	3,173	22	3,537	11	4,149	17	4,524	4,980	10	5,351	7
Total world	8,046	9,095	13	9,007	†1	9,995	11	11,443	12,039	5	12,545	4

*Partly estimated. †Decrease.

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In view of the armed conflicts in several countries abroad, together with the military preparedness program in this country and in western Europe, it seems important to have an indication to what extent the petroleum industry can provide oil from MER production over and above semipeacetime demand as now foreseen. Therefore, in Table 12 forward demand is related to estimated crude producibility (MER) rather than to estimated actual production. This comparison indicates that the industry could provide raw materials (MER) over and above semipeacetime demand to the extent of about 1 million barrels daily in 1951, rising to 1¼ million barrels daily in 1953, or a world shut-in production of about 10 per cent.

During the next 3 years increasingly larger quantities are expected to be transported by pipe lines. The Trans-Arabian line, the Interprovincial line from Edmonton, Canada, to Lake Superior, and the additional Portland-Montreal line, are all expected to be in full operation in 1951.

Additional crude will be moving via 30-in. line before the end of 1953 from the Kirkuk fields to the Mediterranean seaport, Banias. The 34-36-in. Iran-Levantine port project is not expected to be completed until some time after 1953. In the United States additional crude lines will probably be laid tapping new discovered areas particularly in western Texas and also more product lines will be laid very likely in a number of states. Completion of new pipe-line projects will depend of course on the allocation of steel and other materials in accordance with government program for rearmament.

To meet increasing world demand for oil, larger quantities must be transported by tanker. Deadweight tanker tonnage increased substantially during the past 3 years as given in Table 13.

TABLE 13—WORLD TANKER FLEET
(Thousands of tons)

	Deadweight tons	Increase versus previous year	
		Tons	%
Dec. 31, 1947	23,801	....	....
Dec. 31, 1948	24,410	609	2.6
Dec. 31, 1949	25,667	1,257	5.1
Dec. 31, 1950*	27,000	1,333	5.2

*Estimated.

Many shipyards throughout the world are active in tanker construction to provide additional tonnage for replacement of scrapped vessels and to meet normal growth. With the operation of the Trans-Arabian line, additional tankers will be released for other trade routes. This should provide some of the capacity needed for expanding world trade. According to published reports world tanker fleet will be very likely in balance with demand by the end of 1953.

Outlook for World Refining Capacity

A compilation of data from published and private sources pertaining to plans for expansion and erection of new plants (excluding U.S.S.R. and satellite countries) indicates that total world refining capacity will continue to rise during the coming 3 years. According to Table 14 world refining capacity will rise from about 10½ million barrels daily in 1950 to over 12 million barrels in 1953, a gain of about 1½ million barrels daily during a 3-year period.

TABLE 14—WORLD REFINING CAPACITY
(Excluding U.S.S.R. and Satellite Countries)
(Thousands of barrels daily)

	Crude refining capacity (bbl.)	Increase	
		Bbl.	%
Actual—			
1947	8,249	....	....
1948	9,087	838	10.2
1949	10,044	957	10.5
1950*	10,580	536	5.3
Outlook—			
1951	10,924	344	3.3
1952	11,506	582	5.3
1953	12,066	560	4.9

*Partly estimated.

World refining capacity seems to be expanding at about the same rate that we have noted for world demand and world availability of supplies, i.e., about 5 per cent per annum.

Table 15 shows a breakdown of world crude-oil refining capacity according to major geographical areas from which it is noted that since 1947 there has been substantial growth in expansion of refining facilities abroad particularly in the countries of western Europe participating in the Marshall aid plan.

The erection of refining plants in Europe was undertaken as a part of the European recovery plan. The expanding refining facilities in countries west of Suez are intended to complement the development of crude production in the Middle East. The leveling off of refining expansion in the Caribbean and Middle East areas is a further indication that the countries of western Europe will no longer be as dependent as heretofore on refining facilities in these areas to supply their major refined product requirements.

Notwithstanding the fact that the world petroleum industry will have larger refining capacity in the near future there will be little change on

TABLE 16—WORLD CRUDE OIL RUNS VS. WORLD REFINING CAPACITY
(Excluding U.S.S.R. and Satellites)
(Thousands of barrels daily)

Years	Indicated crude runs necessary to meet demand (bbl.)	Refining capacity (bbl.)	Indicated per cent operated
1947	7,653	8,249	93
1948	8,196	9,087	90
1949	8,477	10,044	84
1950*	9,345	10,580	88
1951	9,840	10,924	90
1952	10,276	11,506	89
1953	10,649	12,066	88

*Partly estimated.

TABLE 15—WORLD PETROLEUM CRUDE-OIL REFINING CAPACITY
(Excluding U.S.S.R. and Satellite Countries)
(Thousands of barrels daily)

	Actual refining capacity							Outlook for refining capacity					
	1947	1948		1949		1950*		1951		1952		1953	
Areas—	(bbl.)	Bbl.	% inc. vs. '47	Bbl.	% inc. vs. '48	Bbl.	% inc. vs. '49	Bbl.	% inc. vs. '50	Bbl.	% inc. vs. '51	Bbl.	% inc. vs. '52
United States	5,569	6,034	8	6,439	7	6,617	3	6,737	2	7,000	4	7,300	4
Other North America	398	406	2	504	24	552	10	592	7	613	4	619	1
Caribbean	858	938	9	1,046	12	1,116	7	1,166	4	1,190	2	1,155	†3
Other South America	140	144	3	183	27	206	13	215	4	215	..	225	5
Total Western Hemisphere	6,965	7,522	8	8,172	9	8,491	4	8,710	3	9,018	4	9,299	3
OEEC countries—Europe	353	482	37	651	35	806	24	889	10	1,134	28	1,352	19
Other Eastern Hemisphere—west of Suez	135	139	3	151	9	161	7	182	13	192	5	203	6
Total Eastern Hemisphere—west of Suez	488	621	27	802	29	967	21	1,071	11	1,326	24	1,555	17
Middle East	670	777	16	844	9	865	2	865	..	865	..	865	..
Far East, South and East Africa and Oceania	126	167	33	226	35	257	14	278	8	297	7	347	17
Total east of Suez	796	944	19	1,070	13	1,122	5	1,143	2	1,162	2	1,212	4
Total Eastern Hemisphere	1,284	1,565	22	1,872	20	2,089	12	2,214	6	2,488	12	2,767	11
Total foreign	2,680	3,053	14	3,605	18	3,963	10	4,187	6	4,506	8	4,766	6
Total world	8,249	9,087	10	10,044	11	10,580	5	10,924	3	11,506	5	12,066	5

*Partly estimated †Decrease.

an over-all basis in the margin of excess refining capacity over and above that required to meet demand. In Table 16, indicated crude runs necessary to meet product demand have been related to refining capacity in order to determine the percentage of operation required. This table indicates that for the year 1950 world refineries would have to operate at 88 per cent of capacity in order to meet estimated demand and the same ratio is expected for the year 1953.

In studying quantitative data pertaining to world refining capacity, consideration should be given to the fact that refining facilities in the United States are required to turn out a larger proportion of gasoline and distillates than plants located abroad. This fact is borne out by the data shown in Table 17 which give actual yield percentage for the year 1949.

TABLE 17—REFINERY YIELDS—YEAR 1949

Products—	Per cent yield— United States	Foreign
Gasoline	49.3	24.0
Kerosine	5.3	6.5
Distillates	17.6	16.2
Lubricants	2.3	1.0
Subtotal	74.5	47.7
Residuals	22.1	46.5
Miscellaneous and loss	3.4	5.8
Total	100.0	100.0

It is also to be noted that gasoline yield of United States refineries is more than twice that of foreign refineries and that correspondingly the yield of residuals in plants located abroad is double that of United States refineries. It is also to be observed that the output of United States refineries is 75 per cent high-valued products as compared with only 48 per cent for foreign refineries.

To meet growing demand in the United States for gasoline and distillates, particularly heating oils, will require increasingly larger cracking operations. From Table 18 it is to be noted that cracking capacity in the United States from 1947 onward has increased at the rate of about 100,000 bbl. daily, or about 6 per cent.

TABLE 18—UNITED STATES CRACKING CAPACITY

(Thousands of barrels daily)

	Barrels	Increase versus previous year: Barrels	Per cent
1947	1,515	....	....
1948	1,624	109	7.2
1949	1,715	91	5.6
1950*	1,821	106	6.2

*Partly estimated.

To obtain larger yields of light oils to meet demand and to improve the quality of products supplied by foreign refineries, additional cracking facilities are being erected abroad, particularly in western Europe. Cracking capacity in countries participating in the Marshall plan amounted to only 98,000 bbl. daily in 1949. Total over-all foreign cracking capacity in 1949 amounted to about 1 million barrels daily. However, over 60 per cent of this capacity is located in the large producing-exporting areas of the Caribbean and Middle East.

In the immediate years following the war, the major problem confronting the industry abroad was to provide large quantities of refined products to meet demand. Quality was generally a secondary matter. The trend, as now foreseen, is not only to meet growing demand but also to provide better-quality products with respect to higher-octane gasoline and fuel oils with lower sulfur content.

TABLE 19—FLOW OF PETROLEUM BETWEEN HEMISPHERES
(Excluding U.S.S.R. and Satellites)
(Thousands of barrels daily)

	Years	Crude: Barrels
Flow—Western to Eastern Hemisphere	1938	170
	1949	76
	1953	18
Flow—Eastern to Western Hemisphere	1938	....
	1949	147
	1953	223
Net Flow—To Eastern Hemisphere	1938	170
To Western Hemisphere	1949	71
To Western Hemisphere	1953	205
		Refined products
Flow—Western to Eastern Hemisphere	1938	525
	1949	443
	1953	85
		Total crude and products
Net Flow—To Eastern Hemisphere	1938	695
To Eastern Hemisphere	1949	362
To Western Hemisphere	1953	120

Shifts in International Flow of Oil

Historically the Eastern Hemisphere has been a net importer of crude and refined products from the Western Hemisphere. However, Table 19 indicates that beginning with the year 1949, for the first time, the Western Hemisphere as a whole became a net importer of crude oil to the extent of 71,000 bbl. daily.

By 1953 the Western Hemisphere's net crude-oil imports are expected to exceed 200,000 bbl. daily. This important shift in the flow of crude oil is chiefly attributable to the tremendous stepup in crude-oil production in the Middle East.

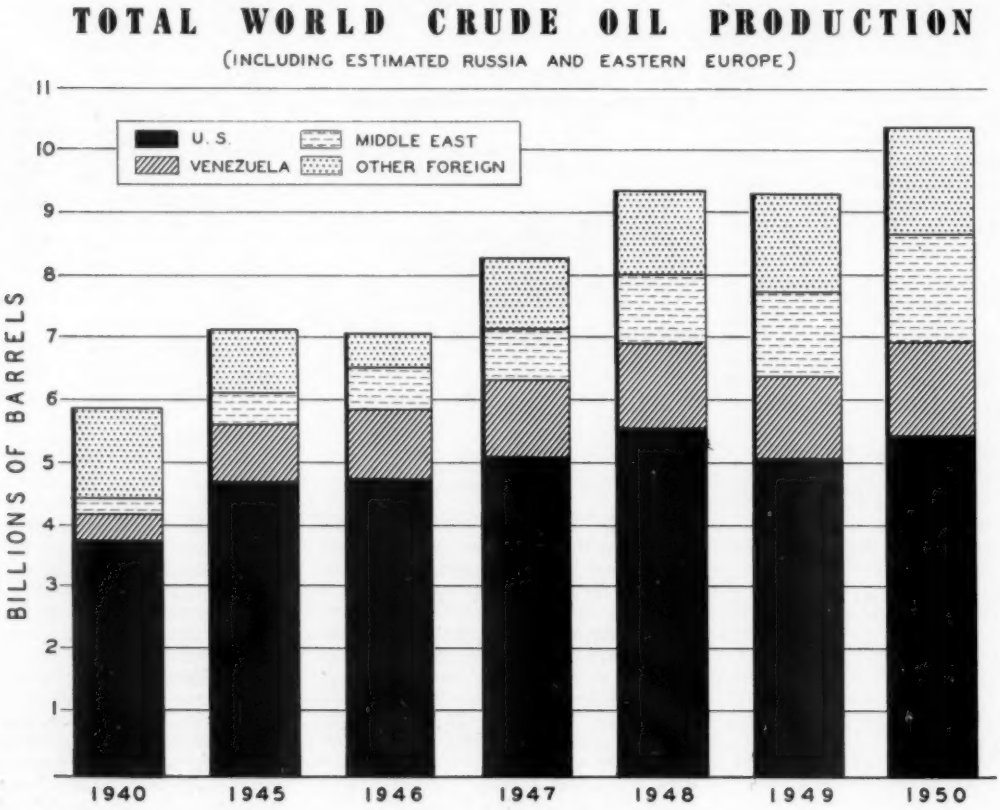
The Western Hemisphere is expected to remain an exporter of refined products to the Eastern Hemisphere. However, Table 19 indicates that refined product exports from the Western Hemisphere that are now in the neighborhood of 400,000 bbl. daily will very likely decline drastically in the ensuing 3 years to a low of only 85,000 bbl. daily in 1953. This decline is due primarily to the substantial refinery expansion program in western Europe. It is expected that refined products exports from the Western Hemisphere to the Eastern Hemisphere will consist chiefly of aviation gasoline, high-grade lubricants, and specialty products only.

Therefore, by 1953 the Western Hemisphere may become a net importer of petroleum (crude and products combined) and correspondingly the Eastern Hemisphere may become

(Continued on page 302)

TABLE 20—FLOW OF OIL TO THE EUROPEAN COUNTRIES PARTICIPATING IN THE MARSHALL PLAN (OEEC)
(Thousands of barrels daily)

Sources of supply—	Crude oil— Bbl.	Per cent total	Refined prod.— Bbl.	Per cent total	Total— Bbl.	Per cent total
1938						
Western Hemisphere	160	60.4	343	84.7	503	75.0
Middle East	105	39.6	62	15.3	167	25.0
Total	265	100.0	405	100.0	670	100.0
Per cent total		39.6		60.4		100.0
1949						
Western Hemisphere	68	13.6	307	64.4	375	38.4
Middle East	432	86.4	170	35.6	602	61.6
Total	500	100.0	477	100.0	977	100.0
Per cent total		51.2		48.8		100.0
1953						
Western Hemisphere	18	1.5	25	18.2	43	3.3
Middle East	1,167	98.5	112	81.8	1,279	96.7
Total	1,185	100.0	137	100.0	1,322	100.0
Per cent total		89.6		10.4		100.0



WORLD PRODUCTION RESUMES *upward trend*

by Dahl M. Duff
International Editor

An increase of 11.5 per cent noted in 1950 over 1949, bringing daily average for year to 10,377,000 barrels

THE year now ending saw a resumption in the upward trend in world production of crude oil after a temporary leveling off in 1949.

Output of crude world-wide in 1950 averaged 10,377,000 bbl. daily, up 11.5 per cent from the previous year. By contrast, production decreased slightly in 1949. In 1947 and 1948, however, world production showed gains of 17.6 and 13 per cent, respectively, over the previous year.

The slump in production in the United States in 1949 and its subsequent recovery in 1950 was largely responsible for the changes in the world total. Crude output of foreign areas, on the other hand, has been rising consistently since the end of the war.

In 1950, total foreign production, including estimated output of Russia and communist Eastern Europe, averaged 4,974,000 bbl. daily. This represented an increase of 16.7 per cent over the previous year. In 1949, foreign production was up 11 per cent over 1948; in 1948, 21.2 per cent; in 1947, 14.3 per cent; and in 1946, 15 per cent.

United States production in 1950 is estimated to have averaged 5,403,000 bbl. daily, a gain of 7.2 per cent over 1949. The pronounced drop in United States output in 1949 represented a decline of 8.6 per cent from 1948. Prior to that, United States output had made postwar percentage gains as follows: 1948, 8.5 per cent over 1947; 1947, 7.1 per cent; and 1946, 1.2 per cent.

Behind all these figures are such factors as the amount of increase in world petroleum demand, changing patterns of oil supply, and related influences, including rationing and currency restrictions abroad. One outstanding fact has been the development of the Middle East as a producing center to meet a large part of the requirements of the Eastern Hemi-

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sphere. The production gain in the area in 1950 over 1949 was nearly 25 per cent.

As a result of this year's upturn in world production, some estimates of demand, particularly foreign, for the next few years have recently been revised and increased. How much of this year's demand has been due to the Korean war and the international situation prevailing since June is, of course, difficult to say. Most of it, however, appears to be result of the increased tempo of business and industrial activity in general, coupled with whatever the normal growth in petroleum consumption may be.

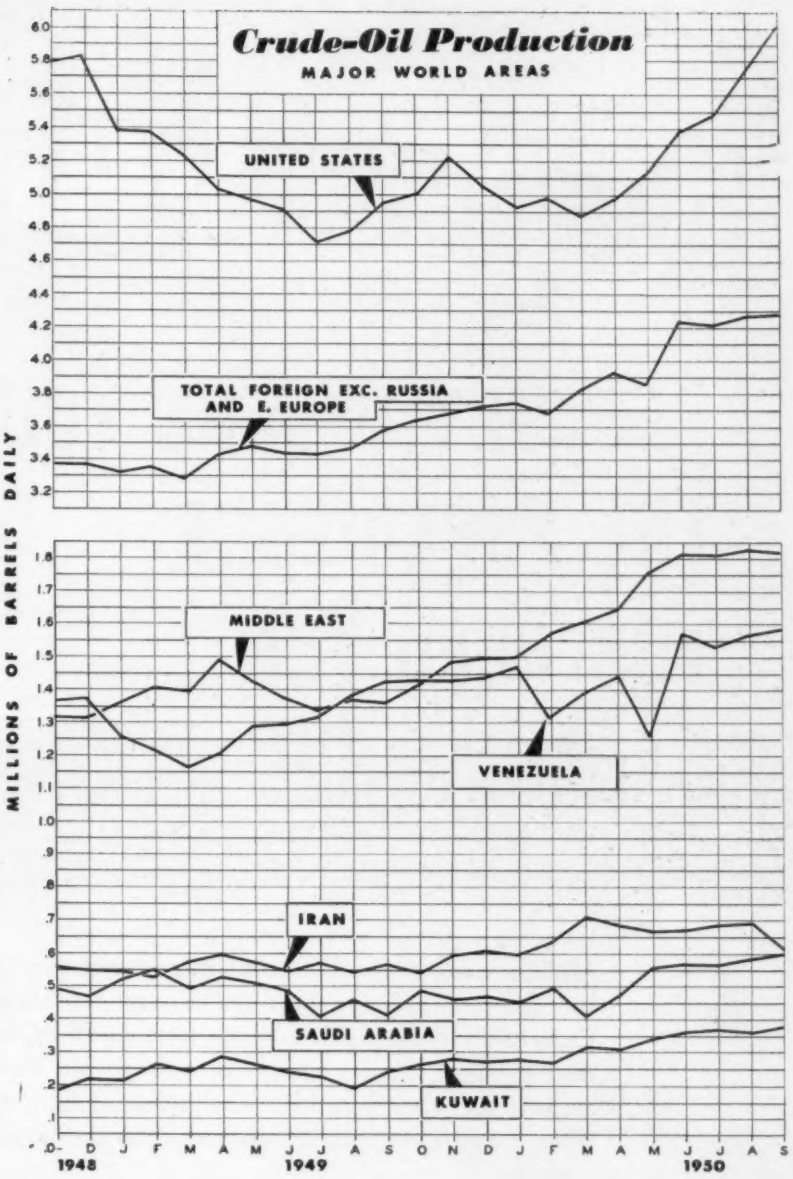
Some of the month-to-month gains in world production during the past year were particularly sharp. Rapid expansion of output both in the United States and in practically all foreign areas was responsible. Month-to-month percentage gains in world production from May to September ran as follows: 1 per cent, 6 per cent, 1 per cent, 2.5 per cent, and 2.3 per cent. In June, world production for the first time went above the 10,000,000-bbl.-daily figure, and in September, it had risen to more than 11,000,000 bbl. daily.

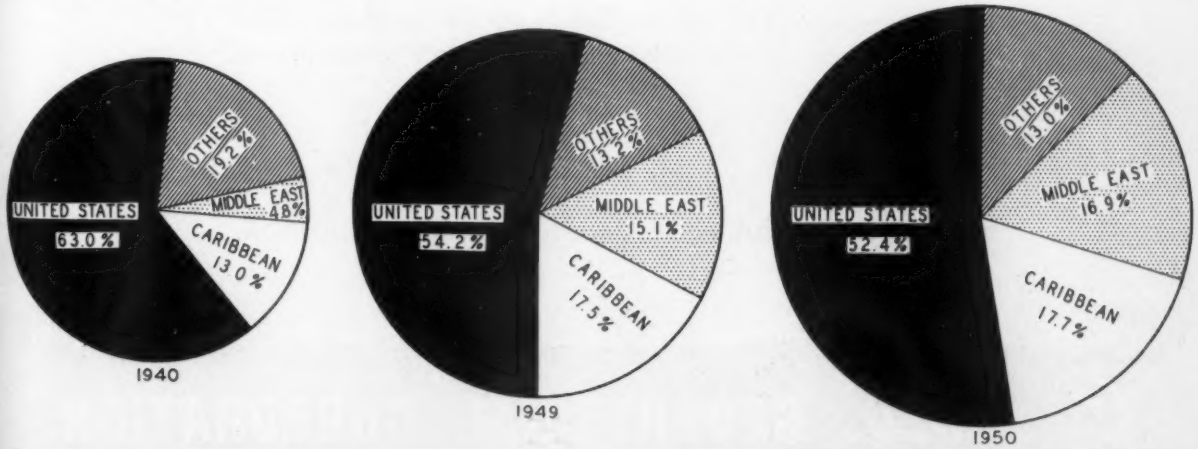
U. S. Share Dropped

Despite its increased production, the share of the United States in the world total in 1950 dropped slightly to 52.4 per cent. In the further expansion of foreign production in 1950, the amount contributed by the Caribbean area to the world total rose to 17.7 per cent, and that by the Middle East to 16.9 per cent.

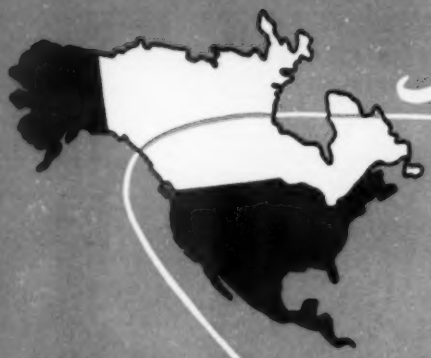
Of the 19 countries of the world outside Russia and Eastern Europe now listed as producing 10,000 bbl. daily or more, 13 of them in 1950 established new all-time highs in crude production. Only one, Peru, showed a decline, and this was but a fraction of a per cent.

Percentage gains in these 19 major producing countries ranged up to the 56.5 per cent increase for Iraq. Countries establishing new production records during the year were Vene-





Percentages of world production reported for important producing areas in 1940, 1949, and 1950. Middle East has had greatest relative gain.



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zuela, Canada, Colombia, Mexico, Germany, the Netherlands, Egypt, British Borneo, as well as all the principal Middle East areas, Iran, Iraq, Saudi Arabia, and Kuwait. The more than 5,900,000 bbl. daily being produced in the United States early in the fall was considerably above the previous peak during the latter part of 1948.

Venezuelan production during 1950 showed an almost unbroken upward trend except during May as a result of the oil strike. This caused a drop of several hundred thousand barrels daily in that month. The record output in this world's largest oil-exporting country was in marked contrast to early 1949 when the drop in the heavy fuel-oil market in the eastern United States caused drastic curtailments in production. Venezuela's production is now nearly three times what it was 10 years ago, and during the latter half of 1950, was up to what is believed to be virtually the maximum producing potential of the country.

Canadian production in 1950 was fairly steady from 70,000 to 80,000 bbl. daily until early fall when the opening of the new Interprovincial pipe line from Edmonton to the head of the Great Lakes was reflected in higher output. Full operation of this line in 1951 will result in a marked increase over 1950.

Another pipe-line project in Colombia accounted for the higher production of that country. This was the installation of added capacity to the Andian National line from De Mares and Casabe to the Caribbean. Completion of this work allowed Colombian production to reach a new record just under 98,000 bbl. daily in July.

Mexican Production Stepped Up

Further development work in Mexico and such projects as the new Salamanca refinery caused a considerably stepped-up crude production in this country. Late in the year, Mexico was producing at about 200,000 bbl. daily. To meet demands for products in the industrialization of the country, Petroleos Mexicanos is working for further expansion of production in 1951.

The old producing areas of Peru were held at a fairly steady rate of some 40,000 bbl. daily. Enlargement of production in this country appears to await broadened exploration activity which hinges on the passage of favorable petroleum legislation, insofar as foreign capital is concerned. In Brazil, the opening of the Bahia refinery with its 2,500-bbl.-daily capacity in September provided an outlet for the previously largely shut-in fields that have been developed in this area.

Considerable exploration work has been under way throughout Western Europe, but here the principal production continues to come from Western Germany and the Netherlands, A French company found a new field in southwestern France which added about 2,000 bbl. daily to the output of the country. Italy's state oil organization, AGIP, continued work in the Upper Po Valley, but the 1949 discovery at Cortemaggiore is reported to be condensate and gas. Italy's small and unchanged crude output come from older fields elsewhere in the Po Valley.

Operators in Germany have been much encouraged by discoveries during the last 2 years. Production has been expanded to some 23,000 bbl. daily at the end of the year, and further development work in 1951 will result in raising this total. Netherlands' crude continues to come from the single Schoonebeek field, but exploration is under way elsewhere in the country, and one gas-field discovery has been made.

Egypt's present production of about 45,000 bbl. daily is considered to be about the maximum that can be taken from existing fields. Further exploration in Egypt has been stalled for the last 2 years by an unfavorable legal situation. Approximately half of Egypt's present production comes from the two new fields discovered since the end of the war in the Sinai Peninsula.

Operations in some of the Middle

World Crude-Oil Production

(Thousands of barrels daily)

Country—	1950 (partly est.)	1949	Per cent change, 1950 vs. 1949	1948	1947	1946	1945	1940	1928
W. Hemisphere:									
Argentina	63.5	61.9	2.6	64.8	59.9	56.4	62.7	56.5	24.9
Bolivia	1.5	1.9	—21.0	1.3	1.3	1.0	1.0	0.8	
Brazil	1.1	0.3	266.6	0.3	0.3	0.2	0.2		
Canada	77.3	57.6	34.2	32.5	20.1	20.8	22.2	23.5	1.7
Chile	1.5	0.4	(*)						
Colombia	93.0	81.2	14.5	64.9	68.1	61.6	61.5	69.8	54.4
Cuba	0.3	0.4	—25.0	0.3	0.7	0.7	0.4	0.3	
Ecuador	7.2	7.2		7.0	6.6	6.4	7.3	6.4	3.0
Mexico	194.4	166.4	16.6	159.5	153.8	135.0	119.4	120.4	137.4
Peru	40.1	40.5	—1.0	38.4	34.9	34.1	37.6	33.1	32.8
Trinidad	56.0	55.1	1.6	54.9	55.7	55.2	57.8	60.8	21.0
Venezuela	1,490.0	1,321.5	12.8	1,338.8	1,190.8	1,063.1	885.4	508.0	289.0
Total	2,025.5	1,794.4	12.9	1,762.7	1,592.2	1,434.5	1,255.5	879.6	564.2
Europe and Africa:									
France	2.3	1.1	109.1	1.1	1.0	1.1	0.5	1.4	1.4
French Morocco	0.8	0.3	167.0	0.2					
Germany (W. Zone)	21.6	15.6	38.4	12.1	11.0	12.1	10.8	20.2	1.7
Italy	0.2	0.2		0.2	0.2	0.2	0.2	0.2	0.1
Netherlands	13.8	11.8	17.0	9.4	4.0	1.2	0.1		
Egypt	44.5	43.2	3.0	36.0	25.5	24.8	25.8	17.8	5.4
United Kingdom	0.9	0.9		0.9	1.0	1.1	1.5	0.3	
Total	84.1	73.1	15.0	59.9	42.7	40.5	38.9	39.9	8.6
Middle East:									
Bahrein	30.4	30.1	1.0	29.8	25.8	22.0	20.0	19.3	
Iran	670.0	561.8	19.3	518.5	422.0	402.2	357.0	181.0	119.0
Iraq	135.0	86.3	56.5	72.2	99.2	97.8	96.2	66.4	2.0
Kuwait	335.0	247.0	35.6	127.2	44.5	16.2			
Qatar	34.0	2.0	(*)						
Saudi Arabia	545.0	476.7	14.3	390.3	246.2	164.0	58.4	13.9	
Turkey	0.8	0.3	167.0						
Total	1,750.2	1,404.2	24.6	1,138.0	837.7	702.2	531.6	280.6	121.0
Other Asia:									
British Borneo	80.0	69.2	15.6	55.0	36.1	5.5	5.5	19.3	14.3
Burma	1.5	0.5	200.0	0.5	0.6	1.9	2.0	21.2	24.0
China	2.0	2.0		1.8	1.1	1.4	1.3		
India†	5.1	5.3	—3.8	5.3	6.1	6.0	6.4	6.3	
Indonesia‡	140.0	115.8	20.9	86.8	22.0	5.8	20.8	170.0	88.0
Japan	5.5	3.8	44.7	3.1	3.6	3.7	4.2	7.2	5.3
New Guinea	4.8	4.7	2.1	0.4					
Pakistan†	3.2	2.0	60.0	1.2					
Total	242.1	203.3	19.1	154.1	69.5	24.3	40.2	224.0	131.6
Total foreign less Russia & E. Europe	4,101.9	3,475.0	18.0	3,114.7	2,542.1	2,201.5	1,866.2	1,424.1	825.4
Est. Russia & E. Europe:									
Austria	23.0	20.0	15.0	17.0	15.9	15.7	8.4	7.7	
Romania	85.0	85.0		93.4	78.0	86.3	95.3	108.0	84.3
Russia	740.0	660.0	12.1	600.0	543.0	449.0	424.0	608.0	234.0
Other E. Europe§	23.8	21.0	13.3	15.2	17.1	20.9	18.1	20.4	15.3
Total	871.8	786.0	10.9	725.6	654.0	571.9	545.8	744.1	333.6
Total foreign	4,973.7	4,261.0	16.7	3,840.3	3,196.1	2,773.4	2,412.0	2,168.2	1,159.0
United States	5,403.0	5,041.9	7.2	5,519.6	5,087.6	4,750.5	4,694.9	3,697.3	2,403.0
World total	10,376.7	9,302.9	11.5	9,359.9	8,283.7	7,023.9	7,106.9	5,865.5	3,622.0

*Commercial production in Chile and Qatar did not begin until the latter part of 1949. †India and Pakistan combined prior to 1948. ‡Western New Guinea listed separately. §Includes Albania, Czechoslovakia, Hungary, Poland, and Yugoslavia.

East countries were beset during the early part of 1950 by difficulties arising out of restrictions against dollar-produced oil. Agreements between several companies and the British Government, along with a general improvement in the foreign-currency situation, removed many of these obstacles, and production in this area has continued the sharp increases it has shown consistently since the end of the war.

Tapline Adds to Output

Opening of the Trans-Arabian pipe line in the latter part of the year added to the output in Saudi Arabia. In October, production in this country was at an all-time peak of 643,000 bbl. daily. Iran established a production record of 707,000 bbl. daily in March. Kuwait averaged about 335,000 bbl. daily during the year, 35.6 per cent above 1949. The operation in Kuwait is even more remarkable in view of the fact that the entire field has been developed since the end of the war.

The Iraq pipe-line outlet to Haifa in Israel continued closed because of the Jewish-Arab strife, but production was increased 56.5 per cent over the depressed level in 1949 by the new 16-in. line to Tripoli. Both these lines extend from Kirkuk field which produces all but about 8,200 bbl. daily of Iraq's crude. The new 30-32-in. from Kirkuk to the Eastern Mediterranean is due to be completed late in 1952, and production will be ultimately tripled over the present total of about 160,000 bbl. daily.

Continued Development

British Borneo's production showed the result of continued development. The area was devastated during the war, and the approximately 85,000 bbl. daily now being produced stems from the reconstruction and expansion that has been carried out by the Shell organization since 1945. The nearly 21 per cent gain in production in Indonesia in 1950 reflects rehabilitation work that is now virtually completed in the main southern Sumatra and eastern Borneo areas. Indonesian production is now nearly back at its prewar level.

Best available estimates of production in Russia and communist Eastern Europe give this entire region an aggregate output of about 872,000 bbl. daily. The Russian daily average of 740,000 bbl. daily is based on the announced Soviet claims of having exceeded 1940 production by 21 per cent in the first 10 months of 1950. The Soviet Mineral Oil Administration has forced up Austria's production considerably and is developing output in its Matzen field. There have been reports of a new discovery in northwest Romania, but production is believed to be still ranging around 85,000 bbl. daily, despite efforts of the communist government to increase this figure.

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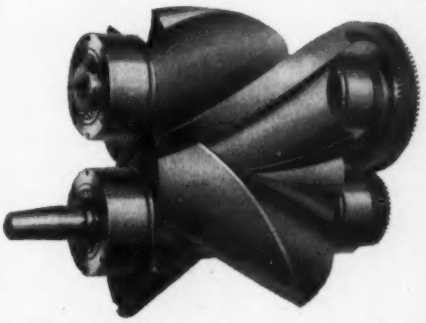

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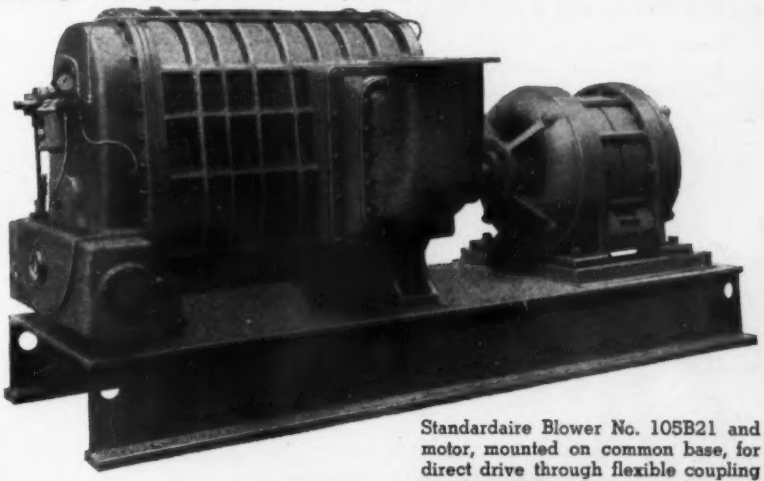

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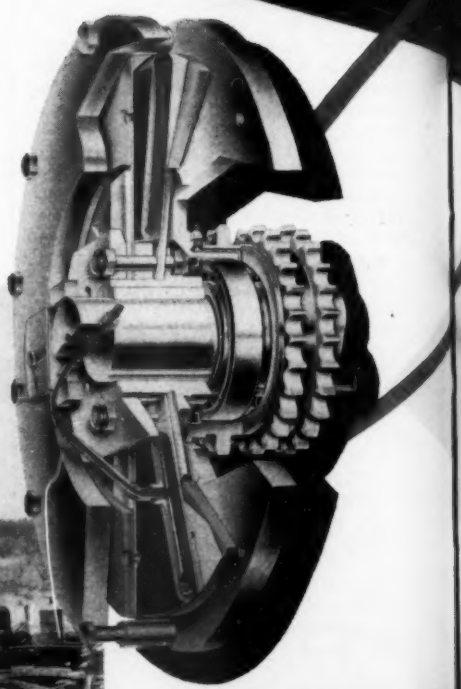

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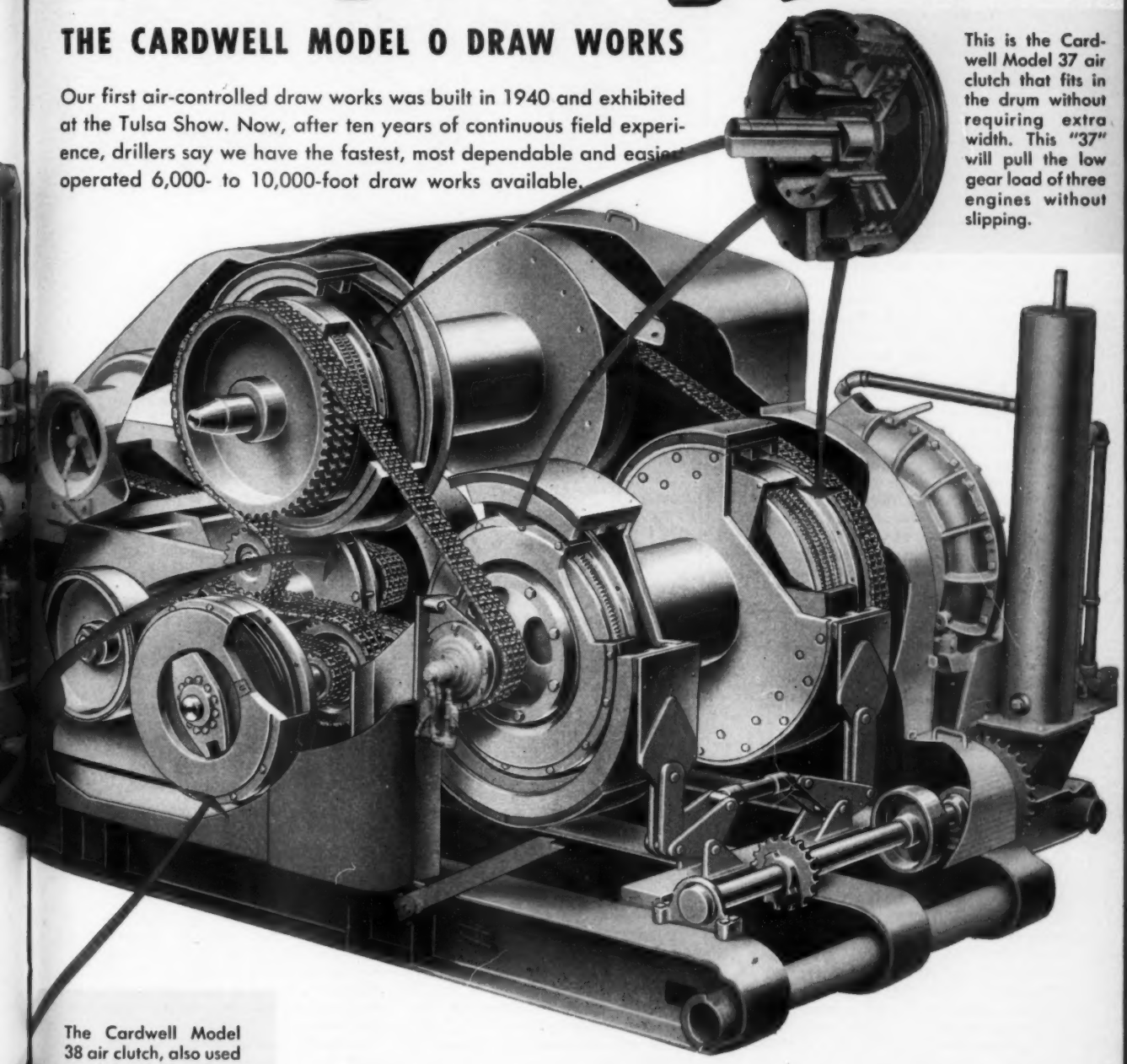

The Cardwell Model 38 air clutch, also used on the pump and rotary table drives . . . is already famous for NO FAILURE, NO ADJUSTMENT AND LONG LIFE WITHOUT REPAIRS.

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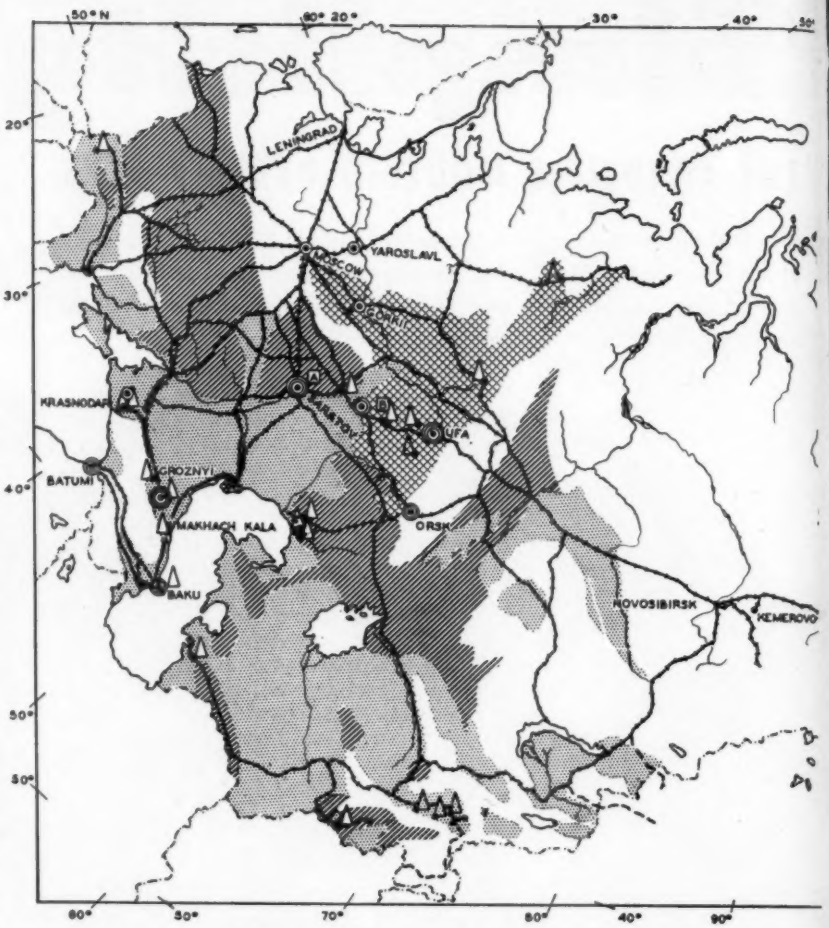
THE AUTHOR

The author, Russian born but American educated, received his doctorate in anthropology at University of California in 1939. During World War II, he was an officer on the War Department General Staff, concentrating on Russian affairs. In 1946-47, as a lieutenant-colonel, he taught at the National War College. In 1947-48 he was at the Institute for Advanced Study in Princeton. Since then, he has been a staff member of the Russian Research Center and of the Department of Social Relations at Harvard University; concurrently, he is consulting editor of Automotive Industries on Russian industrial affairs. He has published numerous articles on technology and human geography, and is the author of "Minerals—A Key to Soviet Power" (Harvard University Press, 1951). The article on Soviet petroleum is based upon extensive published and unpublished materials available to the Russian Research Center.



Is Petroleum a S

by Demitri B. Shimkin
Assisted by Nicholas DeWitt

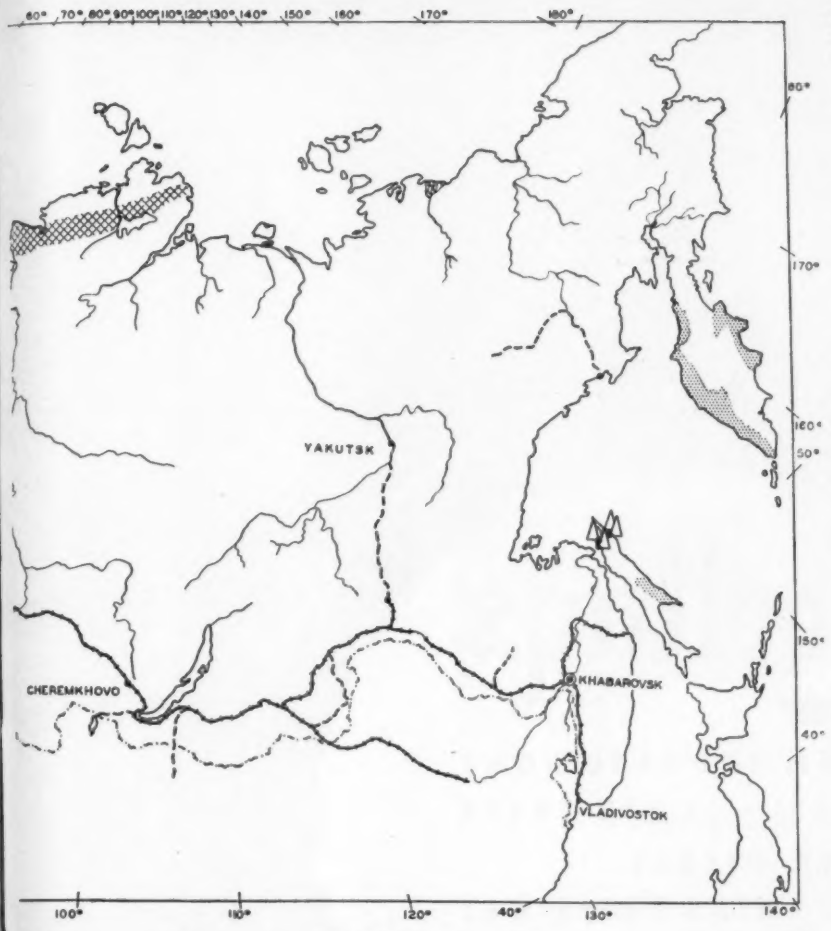
RUSSIA'S oil and gas industry retains major elements of weakness, despite large potential reserves of petroleum and natural gas; considerable progress over the past decade in oilfield operation, in refining, and in expanding natural-gas output; and postwar access to eastern European production. Fundamental defects exist in poorly mastered exploration techniques, an excessively low rate of oil-well completion, a limited and antiquated cracking capacity, low product standards, and primary dependence upon long-range rail hauls in petroleum distribution. Finally, sharply increased needs for truck transportation have more than offset the economies realized from the use of substitute fuels in agriculture within the past 10 years. Thus the U.S.S.R. has become a net importing rather than substantial exporting nation for petroleum products.

In general, however, a sharp distinction must be made between an assessment of the Soviet petroleum position in peace and in war. Russia's weaknesses reflect, above all, deliberate investment choices which have given a low priority to the oil and gas industry. The scale of development has nevertheless been adequate to meet peacetime requirements, given careful economy and reasonable luck. On the other hand, the Soviet oil and gas industry proved grossly incapable of meeting the needs of World War II.

A lack of reserve oil wells and drilling equipment led to a drop in crude-oil output from 31 to 18 million metric tons (from about 225 to 130 million barrels) between 1940 and 1942. The outputs of aviation gasoline and of tetraethyl lead were very small. Lend-lease deliveries, including 25 per cent of all Soviet aviation-gasoline consumption and, especially, three complete catalytic cracking plants were needed to maintain Soviet air power. Ground-forces needs for gasoline were substantially reduced by using diesel engines in armored vehicles. Yet total military requirements forced a slashing of civilian gasoline, naphtha and kerosine consumption to less than half of the prewar level.

Although some of this deficit was made up by conversion to solid fuels via gas-producer attachments, inadequate mechanization became a primary factor in an agricultural crisis so grave that—in Stettinius' words—"By December 1942, food was sometimes taking precedence over steel."

Today, the readiness of the Soviet oil and gas industry for a major war is not substantially greater than in 1940. True, progress has been realized: while the 1949 crude output only equaled that of 1940, improved oilfield operating methods make a sharp decline less likely. Increased and



Left: Map of Soviet oil and gas industry (for names, specific locations, and output of oil and gas fields see Table 1).

LEGEND

SCALE IN MILES
0 100 300 500

PRODUCING OIL FIELDS

CRACKING PLANTS ANNUAL INPUT CAPACITY:
100,000 – 500,000 METRIC TONS
700,000 – 1,500,000 METRIC TONS
2 – 3 MILLION METRIC TONS (AS OF 1947)

PRODUCTIVE SEDIMENTARY FORMATIONS
MIOCENE – PLIOCENE
JURASSIC – EOCENE
DEVONIAN – PERMIAN

PRODUCING GAS FIELDS
CRUDE & PETROLEUM PRODUCTS PIPE LINES
NATURAL-GAS LINES
MAIN PETROLEUM-CARRYING RAILROADS
LONG-DISTANCE HAULAGE HIGHWAYS

Soviet Weakness?

Here's a frank appraisal of U.S.S.R.'s oil situation— Its strength, its weaknesses, production and reserves

partly modernized cracking capacity has permitted the rise of gasoline output to some 7.4 million metric tons (62.8 million barrels), twice that of 1940, while aviation-gasoline capacity, at some 1.7 million metric tons (14.6 million barrels) annually, is nearly 20 times as great. Despite a substantial increase in tractors and mechanized agricultural operations, the country's naphtha and kerosine requirements only approximate the prewar level, thanks to continuing use of solid fuels, and to the introduction of diesel-fueled tractors.

On the other hand, because of a much smaller margin in locomotives and railroad rolling stock, the irreducible civilian needs for trucking are far higher than in 1940. Soviet aviation-gasoline capacity is still but 10 per cent of the American. Increased motorization in the ground forces has raised their needs; Soviet naval requirements have grown especially fast. Finally, eastern European satellite production is far lower than in 1940, and exports from these regions to the Soviet Union have been maintained only by drastic cuts in their own consumption. In case of war, their armed forces and, in addition, the Chinese would represent added drains.

These interpretations can be supported by a more detailed examination of petroleum and natural-gas resources, oil-field operation methods, crude-oil and natural-gas production, refining, consumption (including petroleum substitutes and imports), and distribution in the Soviet Union.

Resources

The Soviet Union is characterized by extensive sedimentary formations, covering about 3.5 million square miles, or 45 per cent of its land surface. Consequently, the existence of large petroleum reserves appears probable. Fohs, in a recent summary, has estimated the volume and content of these sediments, and concluded that the ultimate oil-gas reserves of the more promising regions in European Russia, Central Asia, and eastern Sakhalin alone come to 162 billion barrels. His grand total including completely unproven areas in western and northeastern Siberia aggregates 195 billion barrels, twice the United States potential. These estimates may be too high. The Soviet figures of 1939 guess only at 8,690 million metric tons, or some 65 billion barrels (including dry natural gas). Their coverage must, however, be extended, since they include no estimates for the Moscow basin, the Ukraine, or Siberia. Adding these would give about 100 billion barrels, a possible maximum.

Developed (Soviet Class A) reserves constitute but a fraction of the totals given, 230 million metric tons in 1937; the aggregate of "visible" (A + B) reserves in that year was 652 million metric tons. But visible reserves are in fact highly unreliable. Thus, in 1939, the 1937 figures had to be revised drastically. In addition to increases marking discoveries at Tuimazy, on the Volga, abrupt decreases could be noted for the Emba fields in Kazakhstan—from 31.9 to 13.0 million metric tons—and for the Pechora fields of North Russia—from 10.7 to 1.0 million metric tons. In all, it is quite clear that the Soviets maintain but a slim margin of as-

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sured reserves. Incomplete control of geophysical techniques and inadequate exploratory drilling were admitted causes for this situation as late as 1950.

The geological and geographical distribution of Soviet oil reserves is of some interest. Fedorov's comprehensive study in 1939 shows that 81 per cent of the country's visible reserves as of that year were comprised in upper Tertiary, primarily Pliocene, formations in the Caucasus, the Trans-Caspian Plain, and Sakhalin.

It is noteworthy that sizable promising regions of Pliocene marine deposition in the southern Ukraine, the lower Volga, and east of the Aral Sea have not yet been systematically explored (see Fig. 1 and Table 1). Next in significance, with 16 per cent of the visible reserves, were the Paleozoic, especially Permian and Carboniferous, formations of the Volga basin ("second Baku"), which also underlie the Jurassic salt domes of Emba field and the northern Ukraine. During World War II, Devonian formations in the Volga also achieved importance. Finally, Eocene to Cretaceous formations have had a limited significance, forming the productive horizons in the foothills of Central Asia.

Soviet petroleum resources are well located to supply the Moscow-Gorkii-Kuibyshev and Urals industrial areas. On the other hand, the Ukraine, the Baltic States, Leningrad and Northwest Russia must depend on lengthy hauls. The petroleum supply of Siberia between the Urals and Lake Baikal is especially difficult. Soviet petroleum exploration in this latter region has been intense, especially so in the Arctic Yenisei-Khatanga depression and at Lake Baikal, but thus far without evident success. Sakhalin is believed to be yet the sole proven oil region in Siberia.

Oil-Field Development

Inadequate numbers of wells, limited well depths, and, until recently, primitive operating techniques have seriously hindered effective Soviet use of petroleum resources. Prior to World War II, 1,400-1,500 wells were put into operation annually, so that the number of active wells grew from some 6,000 in 1934 to about 15,000 in 1941. In years 1942 through 1946, however, barely 2,500 wells were completed, scarcely equaling the number of exhaustions over that period. The fourth Five-Year Plan has called for the completion of 5,500 operating wells, 3,500 of them in the Volga region, during 1946-1950, inclusive. Actual progress is not known.

In 1939, the maximum depth of operating wells, at Baku, was 8,250 ft.; elsewhere in the Caucasus and across the Caspian at Neftedag, 6,600 ft.; and, in all other parts of the Soviet Union, only 2,600 ft. During the war, although deep drilling in

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The Russian Research Center

The Russian Research Center at Harvard University was established in February 1948 by a grant of Carnegie Corp. Directed by the well-known anthropologist, Prof. Clyde Kluckhohn, its major objective is the study of Russian institutions and behavior in an effort to determine the mainsprings of the national action and policies of the Soviet Union. Major emphasis are placed on investigations of the Communist Party in Russia, and of the Russian economy. Since the fall of 1950, the center has been carrying on a refugee interview project in Europe. The results of the center's investigations are published in various technical journals, and in a series of volumes of the Harvard University Press.

the Volga region, reaching 9,600 ft. at Tuimazy, took place, the national average remained only 2,100-2,400 ft. The postwar plan has anticipated average depths of 5,740-6,500 ft. in the Volga, and much shallower wells elsewhere, except at Baku. Important reasons for the small number of well completions and limited well depths have been inadequate supplies of drilling equipment, pipe and barite. Postwar control of eastern Germany has eliminated Soviet deficiencies in barite.

Prior to the end of World War II, the Russians relied, in the operation of oil wells, upon natural pressure, periodically increased by injections of HCl or HCl plus NaOH, or by explosions; and upon pumping. As a result, their wells ceased production after but 15 to 25 per cent depletion of the potential petroleum reserves. Only since 1944 have secondary-recovery techniques, based upon air, natural gas, and water injection, been practiced. Even in 1950, however, the use of such more advanced methods was limited to the Caucasus, the Emba fields, and Krasnokamsk and Tuimazy in the Volga basin.

Crude-Oil and Natural-Gas Output

Soviet backwardness in oil-field development led to wide gaps between goals and results in production; during World War II, it resulted in a one-third drop in output, recovered only by 1949. Thus the second Five-Year Plan contemplated a rise from 21.4 million metric tons (155 million barrels) of crude and 905 million cubic meters (32 billion cubic feet) of natural gas in 1932 to 44.3 million metric tons (322 million barrels) of crude and 2.5 billion cubic meters (88.3 billion cubic feet) of natural gas in 1937. The actual figures for 1937 were 28.5 million metric tons (207 million barrels) and 1.98 billion cubic meters (69.5 billion cubic feet).

TABLE 1—SOVIET OIL AND GAS FIELDS

Region and field—	Location		Output in thousands of metric tons 1937	1947
Oil fields:				
Baku:			21,370	14,700
(a) Bibi Eibat*	40° 21′ N	49° 48′ E	3,854	....
(b) Lenin*	40° 29′ N	49° 57′ E	4,379	....
(c) Surakhan*	40° 27′ N	50° 18′ E	3,469	....
(d) Artem Island*	40° 30′ N	50° 18′ E	766	....
(e) Binagady*	40° 27′ N	49° 45′ E	442	....
(f) Puta†	40° 21′ N	49° 38′ E	367	....
(g) Kara-Chukhur†	40° 25′ N	50° 0′ E	1,689	....
(h) Kala	40° 27′ N	50° 10′ E	4,046	....
(i) Lok-Batan	40° 22′ N	49° 43′ E	1,799	....
(j) Zykh	40° 23′ N	49° 59′ E	359	....
Groznyi:			2,729	2,100
(a) Starogroznenskii*	43° 21′ N	45° 38′ E	386	....
(b) Novogroznenskii*	43° 18′ N	45° 42′ E	1,191	....
(c) Maygobek	43° 38′ N	44° 30′ E	975	....
Kuban-Black Sea:			1,433	100
(a) Maikop (Neftyannaya)*	44° 25′ N	39° 40′ E	707	....
(b) Khadyzhinsk*	44° 26′ N	39° 32′ E	184	....
Dagestan:			175	550
(a) Izberbash	42° 37′ N	47° 52′ E	150	....
Second Baku:			1,003	5,090
(a) Ishimbai	53° 25′ N	56° 01′ E	962	
(b) Tuimazy	54° 20′ N	53° 45′ E	0	2,400
(c) Syzran-Stavropol	53° 15′-30′ N	48° 30′-49° 30′ E	0	2,100
(d) Buguruslan	53° 36′ N.	52° 25′ E	0	430
(e) Krasnokamsk-Severokamsk	58° 05′-20′ N	55° 45′-56° 10′ E	0	160
Emba:			484	1,070
(a) Makat*	47° 43′ N	53° 10′ E	133	....
(b) Baichunas	47° 16′ N	52° 55′ E	63	....
(c) Koschagil	46° 50′ N	53° 50′ E	186	....
Turkmen SSR:			452	1,050
(a) Neftedag	39° 22′ N	54° 10′ E	452	....
Fergana:			66	450
(a) Kim-Shorsu*	40° 12′-17′ N	70° 30′-50′ E	36	....
(b) Chimion*	40° 15′ N	71° 40′ E	18	....
(c) Andizhan	40° 40′ N	72° 12′ E	1	....
Upper Amu Darya:			324	80
(a) Khaudag	37° 50′ N	67° 20′ E	292	....
Sakhalin:			‡355	550
(a) Langeri	53° 10′ N	142° 0′ E	....	....
(b) Okha	53° 35′ N	143° 0′ E	....	....
(c) Oz. Sladkoye	53° 20′ N	141° 50′ E	....	....
(d) Ekhabi	53° 30′ N	143° 5′ E	....	....
West Ukraine:			§502	100
(a) Borislav* (approx.)	49° 15′ N	23° 20′ E	§370	....
Pechora:			199	150
(a) Ukhta	63° 35′ N	53° 40′ E	199	....
Total			28,500	26,000
Gas fields:			Output, cu. m.	
A. Yelshanka-Kurdyum	51° 35′-50′ N	46° 9′-12′ E	0	490
B. Pokhvistnevo-Sultangulovo	53° 20′-48′ N	52° 10′-20′ E	0	55

*In operation prior to 1917. †In operation prior to 1930. ‡Excluding Japanese concessions. §Then Polish.

TABLE 2—AVERAGE COMPOSITIONS OF SOVIET NATURAL GASES

Region and field—	Spec. gravity (air)	Composition, per cent: Methane	Ethane	Propane	Butane	Pentane and higher	CO_2	H_2S	Nitrogen
Baku:									
Lenin	0.671	87.9	1.3	0.5	0.4	0.4	9.5	....	....
Bibi Eibat	0.655	87.3	3.3	0.6	1.2	0.5	3.2	....	3.9
Surakhan	0.658	88.8	2.2	1.1	0.5	0.5	6.9	....	....
Groznyi:									
Starogroznenskii	0.975	69.4	6.5	10.4	6.1	7.6	....	....	....
Kuban-Black Sea:									
Shirokaya Balka	0.67	93.3	1.4	0.7	2.1	2.5	....	....	....
Second Baku:									
Ishimbai	1.065	42.4	12.0	20.5	7.1	3.2	1.0	2.8	11.0
Tuimazy	....	41.0	14.8	15.6	7.8	3.3	2.8	2.0	12.7
Buguruslan	0.688	76.2	5.1	2.0	0.7	0.7	0.1	0.1	14.3
Saratov:									
Yelshansk	0.605	93.2	0.7	0.6	0.6	0.5	....	Tr	4.4
Emba:									
Kuslary	0.757	82.7	2.3	4.2	5.6	2.2	1.5	....	1.5
Turkmen SSR:									
Neftedag	....	91.2	3.0	1.8	1.2	0.8	2.0	....	....
West Ukraine:									
Dashava	0.568	97.8	0.5	0.2	0.1	Tr	Tr	....	1.3

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The third Five-Year Plan required an output of 49.5 million metric tons (359 million barrels) of crude oil and 5.5 billion cubic meters (194 billion cubic feet) of natural gas by 1942. Instead, output, after reaching 31.0 million metric tons (225 million barrels) of crude petroleum and about 2 billion cubic meters (70.6 billion cubic feet) of natural gas in 1940, plummeted to 18 million metric tons (130 million barrels) in 1942. By 1945, the production of crude petroleum had increased only to 19.5 million metric tons (141 million barrels; of natural gas, to about 1.5 billion cubic meters (53 billion cubic feet).

The fourth Five-Year Plan has specified an increase of petroleum production to but 35.4 million metric tons (257 million barrels), and of natural gas to 8.4 billion cubic meters (296.6 billion cubic feet) by 1950. The postwar increases in crude-oil output have closely paralleled this modest plan:

Year	Output: Million metric tons	Output: Million bbl.
1946	21.7	158
1947	25.9	188
1948	29.2	212
1949	31.0	225
1950 (9-month rate)	34.7	252

In contrast, natural-gas output has lagged seriously, about 1.7 billion cubic meters in 1946; 2.1 in 1947; 2.3 in 1948; 2.35 in 1949; and a rate of 2.6 billion cubic meters for the first 9 months of 1950. (This corresponds

TABLE 3—SPECIFICATION OF SELECTED SOVIET CRUDE OILS

Region and field*—	Sp. gr. (20° C.)	Composition (%): Paraffin (gold)	Composition (%): Sulfur (bomb)	Composition (%): Gum	Coke (Conradson)	Acidity: mg. KOH per gm.	Acidity: % SO_3	Distillation recoveries,† (%): Aviation gasoline	Motor gasoline	Kerosine	Gas oil, diesel oil, etc.	Residual fuel oil, greases, asphalt, etc.
Baku:												
Lenin (L)	0.87	1.03	0.14	13.6	1.0	2.06	0.15	2.0	10.3	23.2	43.3	20
(H)	0.92	0.47	0.3	26	2.5	2.28	0.16	0	6.2	7.4	33	53
Groznyi:												
Malgobek (L)	0.85	7.4	0.3	30	...	0.07	0.01	8.5	16.3	25.0	30	20
(H)	0.92	3.1	0.45	32	...	0.17	0.01	0.7	2.1	7.4	40	50
Kuban-Black Sea:												
Maikop (L)	0.83	...	0.18	14	0	0.4	0.03	12.8	20.2	16.9	33	17
(H)	0.89	1.6	0.22	20	2.37	...	...	2.1	7.8	11.9	28	49
Dagestan:												
Izberbash	0.83	5-8	0.17	12	0	5	0.00	22.7	4.9	31.2	40	0
Second Baku:												
Ishimbai	0.87	1.4	2.6	30	...	0.11	0.08	8.9	11.1	19.0	25	36
Krasnokamsk	0.95	1.2	5.4	54	9.3	0.8	0.05	6.5	6.6	18.7	7	60
Syzran	0.89	...	2.1	41	5.8	0.11	0.01	4.2	5.5	16.7	12+	61—
Emba:												
Makat	0.90	0.5	0.2-0.3	12-24	0.8-1.1	0.28-0.8	0.02-0.06	0	0.2	7	91.6	0
Turkmen SSR:												
Neftedag	0.88	0.4	0.3	30	...	2.3	0.17	1.8	13.4	21	46	18
Upper Amu Darya:												
Khaudag	0.94	3.3	3.2	69	8.8	0.08	0.00	1.1	4.9	8.2	20	65
Fergana:												
Kim (Eastern)	0.85	2.6	0.3	21	3.6	0.05	0.00	6.4	18.0	18.6	40	15
Chimion	0.87	4.8	0.3	25	4.6	0.08	0.01	3.8	10.8	18.8	34	22
Sakhalin:												
Okha (L)	0.87	1.13	0.28	20	2.7	0.11	0.05	3.1	15.4	16.4	32	32
(H)	0.94	0.11	0.37	43	4.0	0.74	0.05	0	0.7	0.7	28	70
Pechora:												
Ukhta (Chibyu)	0.87	...	1.02	41	...	0.11	0.01	8.8	11.9	21.6	...	...

*Characteristics of representative crude. †Fractions of the following maximum spacific gravities: Aviation gasoline, 0.73; motor gasoline, 0.79; kerosine, 0.85; gas oil, diesel oil, etc., 0.92; residual fuel oil, greases, asphalt, petroleum coke, over 0.92.

TABLE 4—COMPARATIVE SPECIFICATIONS: RUSSIA AND U. S. GASOLINES

Gasoline—	Minimum per cent evaporated at temperature (°F): 10 per cent	50 per cent	90 per cent	Maximum admixtures: Distillation residue (per cent)	Gum (mg. per 100 ml.)	Sulfur (per cent)	Octane rating
Soviet official specifications and tests:							
Krzhivitskii report, 1942-43:							
(a) Indicated standard	*185	*276	*420	1.5	5		64-65
(b) Actual tests:							
Sample 1	*218	*286	*429	2.5	...	...	58.5
Sample 2	*231	*311	*440	2.5	...	...	56
Sample 5	*188	*282	*421	2	...	...	57.1
Specifications (1943-49):							
(a) Wartime (GOST V 2084-43)	*200	347	446		10	...	60-70[1]
(b) 1946: Standard (GOST 2084-46)	185	302	410	1.5	10	...	60-70[1]
Winter (GOST 3254-46)	163	284	374	1.5	10	...	60-70[1]
ZIS 110 Special (GOST 3297-46)[2]	158	221	329	...	...	...	74
(c) 1949: A 66	174	293	383	1.5	25	0.15-0.4[3]	66[4]
A 70	174	293	383	1.5	25	0.15-0.4[3]	70[4]
A 74[5]	158	221	331	1.5	6	0.1	74
Aviation gasolines:							
(a) 1942-43: KB-70	...	...	under 302	1.2	2	...	70-89[6]
B-70	...	...	under 302	1.5	2	...	70-89[6]
(b) 1949: B-70	190	221	293	...	...	0.05	70-89[6]
B 95-130 Baku	180	221	293	...	...	0.05	78-95-130[7]
B 100-130[8]	167	221	293	...	...	0.05	-100-130[7]
A.S.T.M. minimum (1946):							
Type A (Normal)	140 (w)-158 (s)	284	392	2	7	...	70-77[9]
Type B (High volatility)	140 (w)-158 (s)	257	356	2	7	...	70-77[9]
Type C (Low volatility)	167	284	392	2	7	...	50
Krzhivitskii minimum recommendations:							
Winter	122-140	230-241	351	...	...	...	70
Summer	172-176	298	385	...	...	...	70

*Interpolated. (1) 60-octane unleaded, for ZIS-5, GAZ-AA; 70-octane, with 1.5 cc. of tetraethyl lead (R-9) per kg. of gasoline, for postwar vehicle models. (2) For Soviet copy of 1941 Packard. (3) With Volga basin crudes, 0.4 per cent S. (4) With 1.5 cc. tetraethyl lead per kg. of gasoline. (5) Unleaded stock for aviation gasoline B92; used in ZIS 110. (6) On left, unleaded; on right, with 4.0 cc. tetraethyl lead per kg. of gasoline. (7) On left, unleaded; center, with 3.3 cc. tetraethyl lead per kg. of gasoline; on right, "equivalent" with rich mixture at maximum r.p.m. (8) Cracked gasoline with isobutane, alkylate, etc., added. (9) Premium, on right. Octane ratings, except "130" octane, determined by A.S.T.M.-type motor test.

to 60 billion cubic feet in 1946; 74.2 in 1947; 81.2 in 1948; 83.0 in 1949; and 91.8 for the first 9 months of 1950.) Three reasons explain this lag:

1. Soviet natural gases, except at Groznyi, are uniformly low in pentane and higher hydrocarbons, and thus of little value in producing natural gasoline (see Table 2). Hence, that industrial area has provided little incentive for increasing natural-gas output.

2. The inadequate availability of pipe and of pumping equipment have sharply restricted the use of natural gas as a fuel. Before World War II, only Baku utilized natural gas in industry and domestically; at other fields, such gas was often destroyed in open-air flares. In 1943, however, a gas line from the Pokhvistnevo field to Kuibyshev was opened; supplies from Sultangulovo were also being piped in by 1947, giving a daily average total of 150,000 cubic meters (5.3 million cubic feet) by 1948. The only other gas-field development also began in 1943, at Yelshanka-Kurdyum field, whence gas was piped to Saratov. In 1945, after receipt of large quantities of lend-lease pipe and pumping equipment, the Soviets began a pipe-line extension to Moscow, which they completed in August 1947. Capacity operation, at 1,350,000 cubic meters (47.7 million cubic feet) daily, was reached by October of that year (see Fig. 1).

3. An increasing proportion of the natural gas produced at oil fields must be pumped back in order to maintain dome pressures.

Regional Shift Is Noteworthy

The regional shift in Soviet petroleum production since 1937 is noteworthy. As can be seen from Table 1, 90 per cent of the 1937 production came from the Caucasus, 5.2 per cent from Central Asia, and 1.2 per cent from Sakhalin. During the succeeding decade, output at Baku and in the Kuban-Black Sea fields dropped sharply, while four fields were brought into production or expanded in the Volga region (Tuimazy, Syzran-Stavropol, Buguruslan and Krasnokamsk); three others, in the Fergana Valley (Kim-Shorsu, Chimion, and Andizhan). In addition, the Soviets expropriated the former Japanese concessions in northern Sakhalin, and incorporated the erstwhile Polish field at Borislav into the Ukraine. Consequently, only 67 per cent of the national output in 1947 came from the Caucasus; the Volga and Emba contributed 23.7 per cent.

By 1950, although recovery in the Kuban and Groznyi field had raised Caucasus output to some 19 million metric tons (138 million barrels), and prewar output was being equaled at Borislav, 44 per cent of the national total derived from the eastern regions, especially the Volga basin, Emba, and Central Asia. The growth of production in these latter areas is significant because of their proximity to heavy consuming centers in Central Russia, the Urals and Central Asia, but these locational advantages can as yet be realized only in part.

The growth of crude-oil output since 1947 at nearly twice the rate of increases in cracking capacity, 3 to 4 million metric tons, or about 21.8 to 29.0 million barrels, has necessitated a large amount of crosshauling of crude and refined petroleum products. Furthermore, the crudes from "second Baku," have very high sulfur contents, up to 5.4 per cent, offering many difficulties in refining (see Tables 3 and 4). Finally, the increases in supply from peripheral areas—Sakhalin, Pechora, and western Ukraine—have somewhat lessened pressure on Russian transportation.

Refining

With few exceptions, largely the light oils of the North Caucasus, Soviet crudes are characterized by gasoline fractions running only 5-10 per cent, and by naphtha and kerosine fractions totaling by 15-20 per cent. In contrast, these crudes are rich in gas-oil fractions, which average 35-40 per cent (see Table 3). From these facts, it is clear that cracking is exceptionally important for the Soviet petroleum industry. Neverthe-

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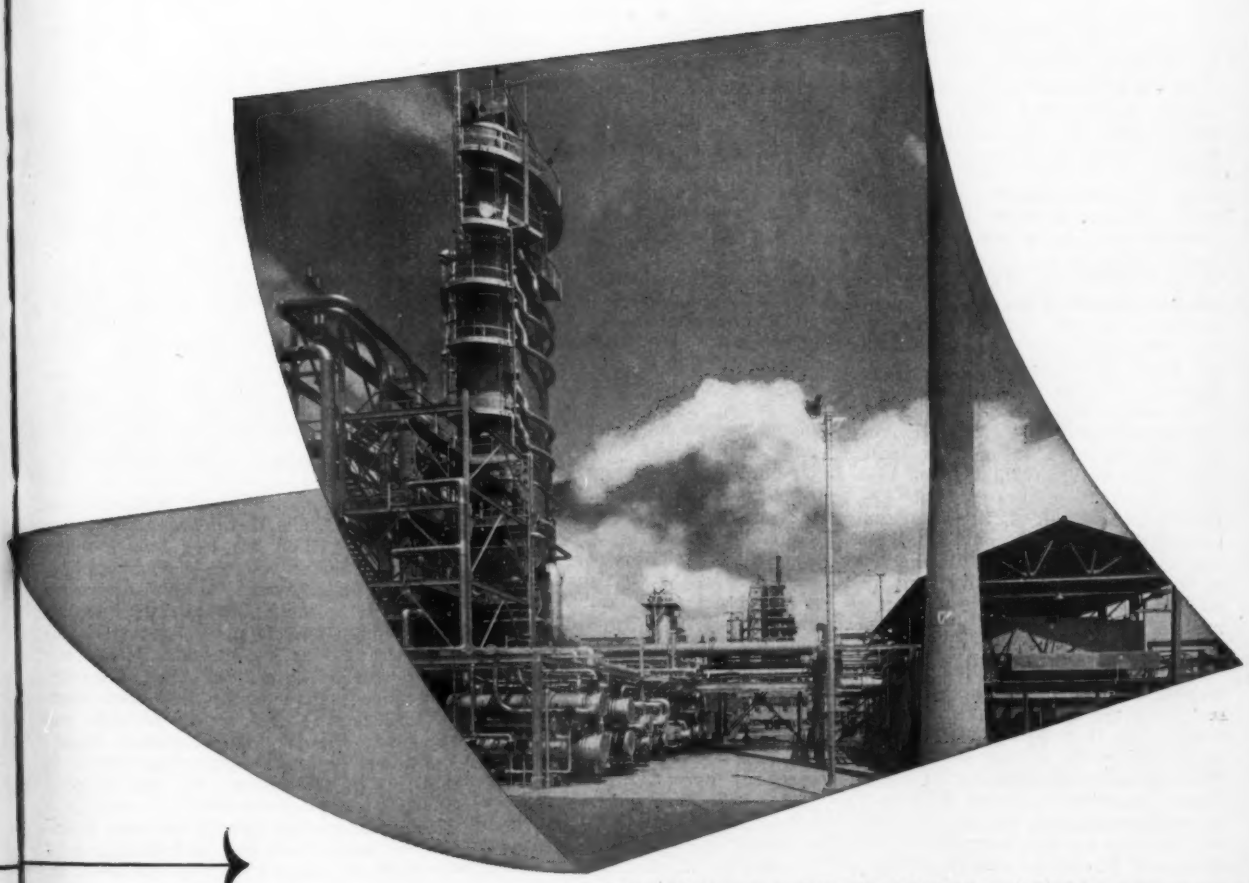

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less, Russian progress in cracking has been slow.

The installation of cracking plants began in 1926; by 1937, the national capacity, all comprised in Winkler-Koch thermal-cracking units, totaled 9.26 million metric tons, or about 67.2 million barrels. About half of this was comprised in the Caucasus, especially Groznyi, as well as Baku, Batumi, and Krasnodar; almost all the remainder, in the Volga basin, largely Saratov, with smaller plants at Gorkii, Moscow, Yaroslavl, Ufa and Orsk.

In the Ukraine, not more than two plants, aggregating half a million metric tons, or about 3.6 million barrels of crude capacity, had been installed; in the Far East, only Khabarovsk, with 200,000 metric tons (1,450,000 bbl.) capacity. Furthermore, only 70 per cent of the installed national capacity was in operation, and at low efficiency. The average recoveries achieved only 27.1 per cent gasoline, 5.0 per cent naphtha, and 23.7 per cent kerosine, despite a gas-oil feed. In all, cracked production totaled but 1.75 million metric tons (14.9 million barrels) of gasoline, 325,000 metric tons (2.6 million barrels) of naphtha, and 1.5 million metric tons (11.6 million barrels) of kerosine. Straightrun output with 26.4 million metric tons (224 million barrels) distilled, added another 1.3 million metric tons (11.0 million barrels) of gasoline, 970,000 metric tons (7.8 million barrels) or naphtha, and 4.6 million metric tons (35.6 million barrels) of kerosine.

During World War II, Soviet requirements for gasoline and diesel oil soared, while the supply of crude fell from 31 to 18 million metric tons or from 225 to 131 million barrels. The Russian cracking capacity, however, closely approximated the 1937 figure by 1942, expansions at Ufa, Moscow, and Saratov having compensated for the loss of Krasnodar and the Ukrainian plants. Changes in refining became necessary; crude rather than deficient straightrun gas oil was now cracked at the Winkler-Koch plants, recycled to yield 30-34 per cent gasoline, 10 per cent kerosine, and 47 per cent residue. Most important, the Soviets placed in operation three lend-lease Houdry catalytic cracking and alkylation plants, totaling some 3 million metric tons capacity, at Kuibyshev, Ufa and Orsk.

As a result of lend-lease equipment, the Russian output of aviation gasoline rose from about 110,000 metric tons (945,000 bbl.) in 1941 to 1,670,000 metric tons (14,400,000 bbl.) in 1944, with an equivalent quantity of by-product diesel fuel, essential for Soviet tanks and self-propelled guns. Total gasoline production, including straightrun, rose to 4.5 million metric tons (38.3 million barrels) in 1944, but naphtha and kerosine output did not exceed 2.5 million metric tons or about 19.6 million barrels, a third of the 1937 level.

Soviet postwar claims indicate approximately 6 million metric tons of gasoline and 3.5 of kerosine output in 1947; 6.7 and 4.1, in 1948; 7.4 and 4.8 in 1949; and at the **rates** of 8.9 and 5.3, in the first 9 months of 1950. (This corresponds to 51.0 million barrels of gasoline and 27.1 of kerosine output in 1947; 57.0 and 31.7 in 1948; 62.8 and 37.2 in 1949; and at the rates of 75.7 and 41.1 in the first 9 months of 1950.) Data on diesel oil and naphtha output are completely lacking. The increases mentioned apparently reflect a growing supply of crudes; reconstruction at Krasnodar, Odessa, and possibly elsewhere in the Ukraine; and redesign of Soviet thermal cracking plant since 1947. The redesign plans, as outlined by Gun, have called for the addition of a catalytic unit, utilizing vapor-phase cracking in the presence of a suspended aluminum-silicate catalyst. This would increase crude intake capacity by 20 per cent, to 1,314 metric tons (9,550 bbl.) daily, and yield the following products after recycling the 230°-450° C. fraction: gasoline, 37.15 per cent; kerosine, 10.8 per cent; heavy gas oil, 7.0 per cent; coke, 2.13 per cent; residual, 35.57 per cent; and cracking gas and losses, 7.35 per cent. Finally, it is evident that at least 3 million tons of completely new cracking capacity must have been put into operation, probably in the Volga basin, since 1947. Thus Soviet national cracking capacity today approximates 17.5-18.0 million metric tons (127-131 million barrels).

Finally, the quality of Soviet refined products is noticeably low (see Table 4). In automobile and truck gasolines, volatility and octane rating standards have been raised appreciably over the past decade, but permissible gum and sulfur requirements have actually dropped. Furthermore, the volatilities of the standard Soviet truck and car gasolines (A66 and 70) today are actually inferior to those prescribed for minimum-quality white gasoline in the United States, despite the fact that exhaustive studies by Krznivitskii and his associates during World War II proved the Soviet need for exceptionally volatile winter gasolines. An attempt to produce a special winter gasoline in 1946 was abandoned because of refining and storage difficulties.

Soviet aviation gasolines are not impressive. Obviously, poor fuels are still a major economic and military problem in the Soviet Union; the conditions of short vehicle life which the writer described in 1948 are still in evidence.

Consumption and Substitution

In 1937, the Soviet Union was still a substantial exporter of petroleum, but far less so than in 1932, when 6.11 million metric tons were shipped abroad.

The pattern of Soviet petroleum consumption (in million metric tons) for 1937 was:

	Million metric tons	Million bbl.
Crude-oil output	28.5	207.0
Refining losses and consumption	3.5	25.4
Fuel oil and lubricants:		
Exports	1.2	8.4
Shipping	1.3	9.1
Railroads	2.5	17.5
Elec. stations	0.9	6.3
Industry	6.6	46.2
Miscellaneous	2.0	14.0
Total fuel oil and lubricants	14.5	101.5
Gasoline:		
Exports	0.20	1.70
Agriculture	0.95	8.08
Trucking	1.43	12.58
Military and misc.	0.42	3.57
Total gasoline	3.05	25.93
Naphtha:		
Agriculture	0.90	7.20
Military and misc.	0.39	3.12
Total naphtha	1.29	10.32
Kerosine:		
Exports	0.55	4.27
Agriculture	3.80	29.45
Domestic	1.20	9.30
Military and misc.	0.58	4.49
Total kerosine	6.13	47.51

Clearly, agriculture, with a total demand of 5.65 million metric tons (44.73 million barrels), was a major consumer of petroleum products. Yet, according to Jasny, only 70 per cent of the plowing, 55 per cent of the seeding, and 45 per cent of the harvesting was being done by tractor-power in that year. Also of significance is the continuing importance of kerosine as a source of light and heat. Finally, the regional breakdown of petroleum consumption in 1937 is interesting. Of the total of 21.8 million metric tons or about 161.8 million barrels (which excludes refining losses, exports, and shipping), 6 million metric tons was consumed in the Ukraine; 2.5 to 2.0 in Central Asia and Kazakhstan, the North Caucasus, Urals, and Moscow regions; 1.5 to 1.4 in the Transcaucasus, lower Volga, and Northwest Russia; and 800,000 to 500,000 in the upper Volga, western Siberian, eastern Siberian, and Far Eastern regions.

Subsequent information on Soviet petroleum consumption, foreign trade, and employment of substitutes is only approximate. During World War II, military needs were overriding. The output of aviation gasoline rose, as mentioned previously, from 110,000 metric tons (about 1,000,000 bbl.) in 1941 to 1.67 million metric tons (15,045,000 bbl.) in 1944, largely through

TABLE 5—UNITED STATES EXPORTS TO RUSSIA

Year	Aviation gasoline (bbl.)	Bromine (lb.)	Greases, etc. (lb.)
1941	2,546,000	119,000	8,673,000
1942	1,262,000	2,887,000	1,403,000
1943	3,050,000	4,976,000	7,629,000
1944	5,155,000	266,000	6,823,000

lend-lease aid. Direct shipments of petroleum products are listed in Table 5.

In all, a quarter of the aviation gasoline and 45 per cent of the bromine used by Russia in the war was imported. On the other hand, Soviet ground-forces requirements for gasoline, estimated at 1.5 million metric tons (about 12.8 million barrels), and for diesel oil and naphtha, about another million metric tons or roughly 7.7 million barrels had to come entirely from civilian supplies. These, as a net result, fell to not more than 1.3 million metric tons or 11.0 million barrels of gasoline and 2.4 million million metric tons or about 19.8 million barrels of kerosine and naphtha, annually, during 1942-44. To maintain in operation the maximum number of tractors and trucks possible, the Soviets introduced gas-generating attachments which permitted use of wood, peat, or lignite, albeit with a large loss of power. By the end of the war, these substitutes were adding the equivalent of 2.5 million metric tons or 18.2 million barrels of petroleum per year to the Soviet fuel supply.

Nevertheless, the Russians, according to Jasny, were able in 1943 to cultivate but two-thirds of their peak prewar acreage and to gather only 40 per cent of their prewar harvest; in 1945, three-quarters the acreage, and half the harvest. Only lend-lease and rigid rationing saved the Soviet Union from disastrous famines. Finally, even by 1945, Russian civilian trucking, excluding agriculture, did not exceed 40 per cent of the 1940, or 55 per cent of the 1937, level in ton-mileage hauled.

Russian postwar plans have called for 50 per cent more tractor work input in 1950 than in 1937—a 17 per cent increase in acreage, multiplied by a 29 per cent rise in the proportion of mechanized operations. This objective appears to have been reached, since fully 300,000 out of 325,000 tractors scheduled for manufacture during 1946-50 were built by October 1950. Yet kerosine and naphtha output together were somewhat less in 1950 than in 1937, an anomaly explicable by the continued use of solid-fueled tractors and the predominance of these and diesel-fueled tractors in postwar manufacture. In contrast, Soviet civilian gasoline requirements in 1950 totaled about 7.5 million metric tons or 63.8 million barrels, thrice those of 1937. This increase reflects, above all, the rise of Soviet trucking ton-mileage, from 6.7 billion metric ton-miles in 1937, to about 19 in 1950.

Except for long hauls in Central Asia, eastern Siberia, and the Far East (see Fig. 1), almost all trucking traffic is local, the average haulage distance being only 7 to 8 miles. Nevertheless, the development of this trucking has been of immense importance to the overburdened Soviet

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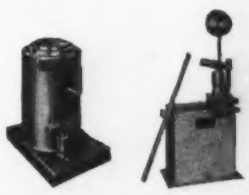
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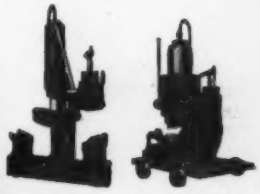
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TABLE 6—U.S.S.R. PIPE LINES

Between—	Number	Diameter (in.)	Capacity— Million metric tons per year	Million bbl. per year
Baku-Batumi	2	8 and 10	1.0 and 1.68	7.27 and 12.2
Groznyi-Makhach Kala	2	8 and 12	0.6 and 1.2	4.4 and 8.7
Groznyi-Tuapse	1	10	1.6	11.6
Armavir-Trudovaya	1	12	1.2	9.3
Guryev-Orsk	1	12	1.2	8.7
Astrakhan-Saratov*	..	..	..	...

*Unconfirmed.

railroads by reducing short hauls, and making possible attendant savings in rolling stock, locomotives, and sidings.

Soviet foreign trade in petroleum products has been restricted almost entirely to its satellites. Between 1946 and 1948, net imports primarily from Romania, are believed to have averaged about 3 million metric tons or about 22.4 million barrels yearly. Since 1949, however, exports to China and Korea may have more than offset diminishing imports from eastern Europe.

Finally, although a goal of 900,000 metric tons of synthetic liquid-fuel production in 1950 has been set, it appears that this industry is still only experimental in the Soviet Union. The Russians are troubled by technical and economic difficulties. Scattered data indicate, in 1949, the presence only of low-pressure, low-temperature hydrogenation, with the recovery primarily of naphtha, from Moscow lignite, and Kemerovo and Cheremkhovo (Siberian) subbituminous coal.

Distribution

Railroads are the basic carriers of crude oil and petroleum products in the U.S.S.R. The Caspian Sea, the Volga River (especially up to Kuibyshev), and the Black Sea are also important. Finally, excluding very small lines, the known pipe lines (see Fig. 1) in Russia are shown in Table 6.

Of the pipe-line systems listed in Table 6, the Groznyi-Tuapse line, connecting the North Caucasus oil fields with the Black Sea coast; and the Armavir-Trudovaya line, providing a supply of kerosine directly to the southeastern Ukraine, were damaged during the war, but have probably been repaired. The Astrakhan-Saratov line has been reported, but is not confirmed. In general, Soviet petroleum pipe lines connect from producing fields to water transportation. Only the Guryev-Orsk line connects an oil field with a cracking plant centered in an important consuming region.

The basic pattern of petroleum distribution in 1937 was the following: from Baku to Astrakhan, then up the Volga to refineries and transshipment to Central Russia, the Urals, and western Siberia (5.0 million metric tons or about 36.4 million barrels). From Baku to Makhach Kala, via water and rail, then across the North Caucasus into the Ukraine, Central Russia, and even the Far East (6.3 million metric tons or about 45.8 million barrels). From Baku to Batumi, then by tanker to Odessa, to the Ukraine, Northwest Russia, and Central Russia (3.2 million metric tons or about 23.3 million barrels). Finally, from Baku across the Caspian to Krasnovodsk, thence, with local production, to Tashkent, western Siberia, eastern Siberia, and the Far East (2.1 million metric tons or about 15.3 million barrels).

During World War II, German advances to Stalingrad disrupted the Volga traffic, which had to be diverted via Krasnovodsk, Tashkent, and Kuibyshev. At present, the traffic pattern is substantially that of the prewar period. The most important changes appear to have been increased traffic in the Volga, Urals, Siberia, and Central Asia, reflecting much greater local production and consumption; large-scale crosshauling of crude petroleum and petroleum products in the Volga and Central Russia, reflecting shortages in cracking capacity; and finally, a partial substitution of Constantsa-Odessa for Batumi-Odessa shipping, because of lowered production in the Caucasus being substituted by Romanian reparations.

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Plans are under way by Colombian Petroleum Co. to revamp its Petrolea Camp refinery to produce kerosine. This refinery is located in the Barco concession of Colombia, and is rated at 840 bbl. daily of crude-oil capacity.

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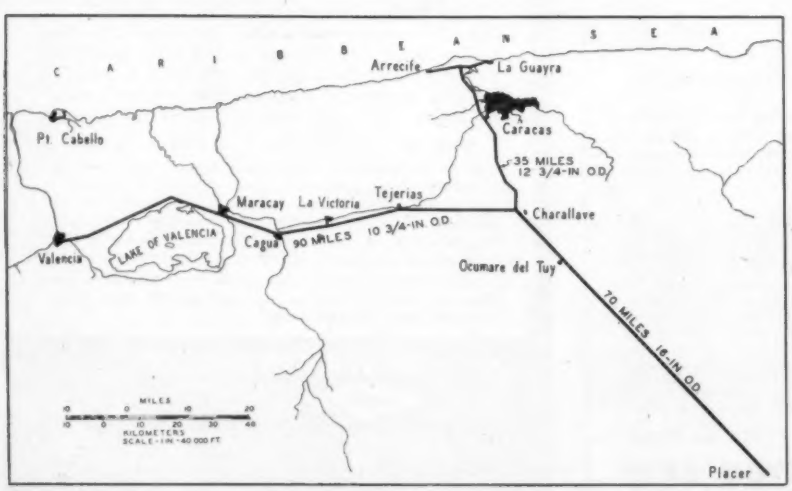
Caracas, one of the Venezuelan cities to be served by the proposed natural gas line.

Vast Market Awaits Development of

VENEZUELA'S NATURAL GAS

by Robert M. Poe*

Here is an enticing situation—a more than adequate supply of gas that is an ideal industrial fuel—a receptive and cooperative government in a financially sound and progressive country—all that is needed is capital and know-how to bring about an industrial and commercial growth that will create profits for all concerned.



In addition to this trunk line system, 80 miles of distribution lines are to be installed to serve industrial areas.

VENEZUELA has an area of 330,000 sq. miles which is about equal to the combined areas of Texas and Oklahoma. Practically every natural resource available to the United States at the turn of the century is now available in Venezuela. Here exists one of the greatest concentrations of undeveloped resources in the world. Venezuela has huge proven reserves of iron ore, richer than any other in the world.

Mineral deposits of gold, diamonds, nickel, asphalt, magnesite, vanadium, tin, gypsum, limestone, and many others are either worked by primitive means or left unworked in immense partially explored areas of the country. Its vast timber resources remain untapped because of inadequate transportation. Venezuela's rivers offer tremendous hydroelectric and irrigational possibilities, and its varied climate and topography afford greatly expanded agricultural and cattle-production possibilities.

Venezuela is a young country—over 60 per cent of the population is under 25 years of age. Its population, estimated conservatively in 1949 to be 4,643,000 (an increase of 20 per cent since 1942), is made up largely of Spanish descendants, Negroes, and Indians.

Since the last war the Venezuelan Government has encouraged the im-

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migration of Europeans, primarily Spanish and Italian, experienced in farming and skilled trades, inasmuch as there is little agriculture in the country and a need for modern housing, as well as development and diversification of industry. The great majority of the people live in the few large cities or in towns of 10,000 to 20,000 population. Caracas, the capital, is the largest city with a population, in the greater metropolitan area, of about 450,000. Other large cities are Maracaibo, Valencia, and Maracay.

The national income of Venezuela in 1949 was 7,000,000,000 bolivars (one bolivar is approximately 30 cents United States currency) and the per capita income was up 300 per cent over 1936. Government expenditures amounted to 420 bolivars per capita between 1948 and 1949. Venezuelan currency has retained a stable relationship to the United States dollar for many years. The Venezuelan Embassy in Washington stated in October 1950 that Venezuelan foreign trade in 1949 represented 80 per cent of the national income. Exports were valued at Bs. 3,360,000,000 and imports, principally from the United States, at Bs. 2,241,000,000. During the first 6 months of 1950, Venezuela bought $201,900,000 in United States products.

Only Petroleum Developed

Of all its natural resources only Venezuela's petroleum has been extensively developed. Venezuela presently has predominantly a one-product economy—petroleum. A major proportion of the country's exports are in petroleum and petroleum products. Concentration on the development of the oil industry has, according to some, retarded the development of other natural resources, industry, agriculture, and commerce because the petroleum industry alone has continued to provide an increasingly large proportion of the national income and of total government revenues. Offsetting this tendency is the tremendous impetus the development of petroleum has given to the growth of industries and commercial enterprises serving the oil industry and its personnel.

Government and businessmen alike have been duly cognizant of the dangers inherent in this situation. The present government has pursued an active and thoroughly sound policy designed to utilize substantial oil revenues to develop resources, programs, and projects encompassing almost every basic phase of economic activity, as well as extensive public works for country-wide civic development. The government and local capital have invested in this program but due to the magnitude of the objectives such efforts alone are insufficient and the government is actively encouraging the entrance of foreign capital and enterprises. The present stake of the United States in Venezuela is tremendous, amounting to some 2 billions of dollars of United States capital invested mostly in oil, iron ore, and engineering projects.

Typical of the terrain to be traversed by the proposed pipe line.

Venezuela's Petroleum

A major portion of the petroleum production in Venezuela is from extensive deposits found in the Maracaibo lowlands which lie between two mountain ranges in the northwestern section of the nation. At the prolific Bolivar Coastal field over 5,000 wells have been drilled. A few years after oil was developed in the Lake Maracaibo area, production was started in the Orinoco River Basin in eastern Venezuela. Still other oil reserves have been discovered in the Apure Basin, a little-explored area in the western central part of the country. While extensive exploration and production have been carried out in the fields of Venezuela, there are still large unexplored areas available for development. Consequently, a great deal of the oil in Venezuela remains to be found.

In connection with the development of the petroleum industry in Venezuela, tremendous reserves of natural gas have been discovered. For all practical purposes it can be stated that these gas reserves have been utilized primarily in conjunction with the normal production of oil, with some small utilization of this important natural resource being made as fuel for camp use, drilling, and pumps.

There has only been a very limited amount of pressure maintenance carried out in the oil fields of Venezuela. Until a recent date, studies of several of the oil companies have failed to reveal the economic feasibility of any large-scale natural-gas utilization and therefore there has been no economic incentive for conservation and vast quantities of natural gas have been flared to the atmosphere. The total extent of the natural-gas reserves in Venezuela is difficult to determine due to the partial development of many of the oil fields. In Table 1 are presented the figures compiled by the Venezuelan Ministry of Development from the available data for 1949.

Natural-gas production for the first 4 months of 1950, according to figures provided by the Embassy of Venezuela in Washington, amounted to approximately 170,200,000 M.c.f., or about 1,420,000 M.c.f. per day. Of this gas production, about 15 per cent has been utilized for fuel and pressure maintenance and the remaining 85 per cent has been flared to the atmosphere.

In the development of the natural resources of Venezuela and the expansion of its industrial economy there are two essential factors required, namely, pioneers and energy. The progressive and cooperative attitude of the government and the economic stability of the country are a matter of record and should be a sufficient stimulus to the pioneering spirit. The tremendous deposits of petroleum and natural gas are available to amply supply the energy necessary to a highly industrialized nation. Actually, fuels and hydroelectric power are the most valuable of the natural resources for it is only by means of their development and application in suitable locations that the availability and value of other resources can be achieved.

Because gas is more readily handled in an industrial plant and its combustion can be more accurately controlled, gas is the preferred fuel to use for industrial development. This is particularly true in Venezuela which is today completely dependent on fuel and diesel oil, most of which must be transported by a maritime supply line to coastal points and then trucked into the interior. The sharp fluctuations in the price of fuel and diesel oil under normal marketing conditions are well known, which makes long-range cost planning uncertain. In addition, it should be borne in mind that natural gas is not a readily exportable product, whereas oil and its products are easily exported and can serve as an additional

substantial source of dollar revenue to the country.

Natural-Gas-Transmission Facilities

The only natural-gas-transmission system in Venezuela at the present time is in the city of Maracaibo. This system is relatively small and is not of great significance in the utilization of Venezuela's natural-gas reserves. The system was installed about 12 years ago and its operation for the last 10 years has been merely as a pipe line. There is virtually no utilization of the pressure control and measuring facilities which were provided to regulate the distribution of gas to the ultimate users.

The natural-gas system serving Maracaibo cannot be properly compared with gas transmission and distribution systems as we know them in the United States. The gas going into the system is measured, but very little metering of the gas to the individual customers is done, with the result that most of the domestic customers receive their gas on a flat-rate basis without regard to actual quantities used and at uncontrolled pressures.

In 1948, E. Holley Poe and Associates were retained by the Venezuelan Government to make a study of the natural resources of the country and the possibilities of industrial development of these resources. At about the same time, Venezuelan Atlantic Refining Co., in recognition of the desirability of rendering assistance to the Venezuelan nation and of the strategic importance of Venezuela to the United States, initiated a thorough study of the economy of the country. The similar conclusions reached by the two studies were that utilization of the presently wasted natural gas would greatly increase the energy output of the country, lead to the diversification of industry needed to strengthen the economy, and stimulate the utilization of other abundant natural resources.

New Natural-Gas Line to Be Built

As a result of these conclusions and as the first major step in the utilization of the natural-gas reserves of Venezuela, Venezuelan Atlantic Transmission Corp., a Delaware corporation, was organized this year and registered to do business in Venezuela. The company was formed by Atlantic Refining Co. and E. Holley Poe for the purpose of installing a large natural-gas-transmission system in Venezuela to provide this superior fuel to the existing and future industries of the country, as well as for domestic distribution at a later date.

Since this pipe line initially will serve only the north-central portion of Venezuela, it is regarded as merely the first step in the eventual development of a natural-gas-transmission system to serve all of the major markets in Venezuela. While the requirements of all of the major natural-gas markets in Venezuela would not utilize all the gas production of the country, due primarily to the absence of any space-heating load, they would nevertheless create a demand for a considerable portion of this production.

The proposed pipe line will originate in the general vicinity of Venezuelan Atlantic Refining Co.'s 1 Placer well, in the State of Guarico, and proceed in a northwesterly direction, passing near the town of Ocumare del Tuy and thence to the town of Charallave. This section of the line will be approximately 70 miles long and will be of 16-in. pipe. From Charallave, a 35-mile section of the line of 12¾-in. pipe will extend north to the city of Caracas and down to the coastal points of La Guaira and Arrecife.

Another section of the line, of 10¾-in. pipe and 90 miles in length, will extend westward from Charallave through the Tuy and Aragua valleys to the cities of Maracay and Valencia. Approximately 80 miles of industrial distribution lines are planned for initial operation. The route of the pipe line will enable the company to serve virtually all of the industrial, commercial, and agricultural regions of central Venezuela. The accompanying map shows this section of the country with the approximate route of the pipe line. The system has been designed to allow for future growth of industry in the area.

The necessary pipe for the construction of this transmission system has been ordered and is now being delivered. It is expected that the deliveries will be completed by March 1951. Due to the present shortage of pipe from United States mills, which are booked to capacity, the entire requirements of pipe for the line were purchased from European mills.

A contract has been made with Williams Brothers for construction of the system which is expected to be substantially completed and in operation by the middle of 1951. Throughout most of its length, where the pipe line passes through virtually uninhabited country, the pipe will be laid on top of the ground, as is common in Venezuela. With the exception of the 90-mile section from Charallave westward to Maracay and Valencia, the route of the pipe line will be through the rugged, mountainous region of north central Venezuela which has steep, heavily wooded slopes and few roads.

At the outset, compressor stations will not be used, since the gas will be delivered to the origin of the line at about 800 psi. and will be forced through the system by this pressure. Compressor stations will be added later when the load has increased sufficiently to require them.

Cost of New Pipe Line

Cost of the transmission system will be approximately $8,000,000, which does not include the gathering and compression system required to deliver gas to the origin of the pipe line. This cost, amounting to 2 or 3 million dollars, will be borne by the supplier, Venezuelan Atlantic Refining Co. Both of the systems are being financed entirely with private capital.

Of the $8,000,000 cost of the transmission system, approximately 5.5 million dollars will be secured by first-mortgage pipe-line bonds. Approximately 1.5 million dollars in equity stock will be issued and it is expected that some of this stock will be made available for private placement with interested investors, both in Venezuela and in the United States.

Venezuelan Atlantic Transmission Corp. will serve only industrial customers. The retailing of gas to domestic and commercial customers will be left to an independent local distribution company to whom the transmission company will sell gas for resale. This company was recently incorporated in Venezuela and is known as C. A. Venezolana Distribuidora de Gas (Vendegas). Vendegas is presently carrying out studies in connection with the installation of domestic and commercial distribution of gas in various cities along the route of the pipe line, starting with Caracas, and discussions are in progress with several utility groups in the United States concerning the details of the project.

Potential Demand

The reserves of natural gas available to the pipe-line system are considered adequate for any demand that might be made upon them for a period of 30 years. Detailed on-the-ground market studies of representative industries have been carried out in the initial areas to be served by the pipe line. Based on these studies, it is estimated conservatively that the initial load of the system will approximate 30,000,000 cu. ft. per day. Many potential consumers and projects were not considered in the initial study, but will be added where it is economically feasible to do so. Based on the market study and the economy of Venezuela, it is estimated that the load growth of the first 5 years of operation will be not less than 20 per cent per year. It is not unreasonable to expect that the providing of natural gas for industrial fuel will lead to a similar industrial development such as has occurred in the Gulf Coast regions of the United States with the development of the natural-gas industry.

Among the industries that could be established or expanded in Venezuela and in which natural gas could be advantageously employed, one of primary importance, which has received considerable publicity in recent months, is the steel industry. Intense

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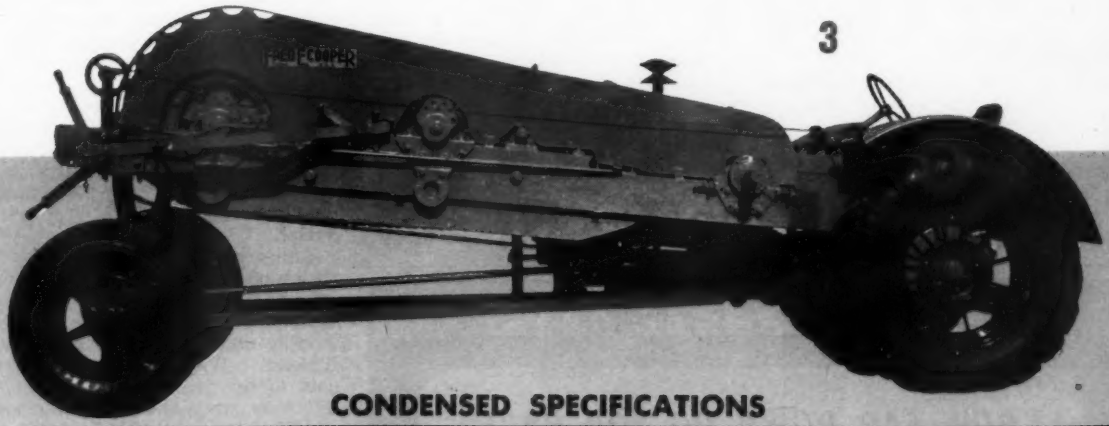

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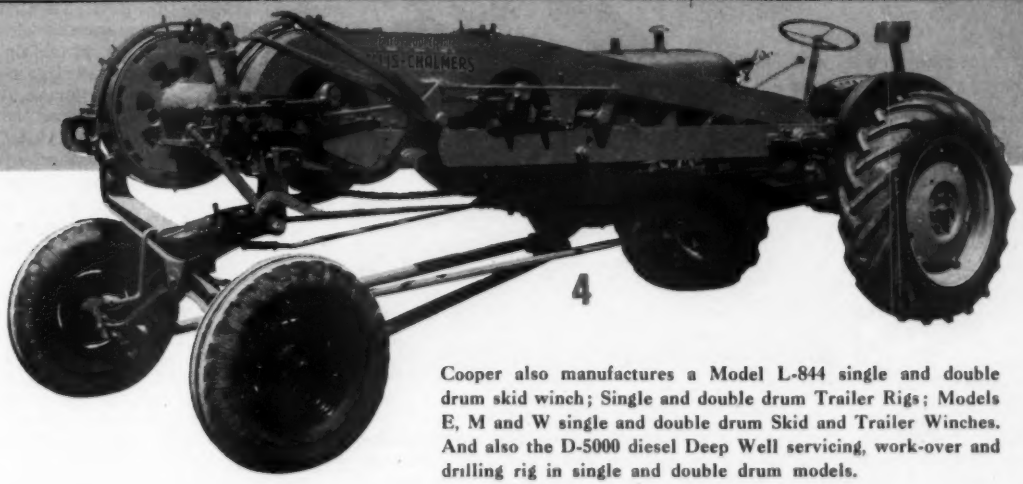
(3) Model M-318	30,300 lbs.	8 from 38′ pm to 1030′ pm	4,800 of ⅝″	32″ x 6″	Optional 15 m.p.h. 30 m.p.h.
(4) Model W-201	16,700 lbs.	8 from 52′ pm to 866′ pm	3,300′ of ⅝″	26″ x 5″	15 m.p.h.



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interest has been aroused by the announcement this year of the development of huge iron ore deposits within the country. Bethlehem Steel Corp. has started shipments of ore from its concessions in Venezuela which are reported to have proven reserves of 60,000,000 tons of ore. Bethlehem's investment in this project will be upwards of $50,000,000.

Early in 1950, United States Steel Co. announced that it had obtained iron-ore concessions in Venezuela amounting to 1 billion tons of high-grade ore. It later announced plans for the expenditure of over $100,000,000 during the next 10 years in developing these concessions. The government and the national economy will obtain great revenues from the mining and export of these iron-ore reserves. In addition, the ready accessibility of natural gas in the region of the iron deposits should make possible the establishment of a steel industry in Venezuela. It is now possible to make iron, and hence steel, economically by a process in which natural gas is substituted for coking coal. The establishment of a steel industry should in turn lead to the formation of other industries to utilize the output of the steel mills.

Other industries that could be commenced or expanded by the use of an assured supply of uniform quality natural gas at an economical, long-term, contracted price include glass, cement, ceramic brick, refractory bricks, aluminum, processed foods, textiles, paper and cartons, lumber, paints and pigments, chemicals, and many others. Natural gas as fuel and raw material could be used to particular advantage in the production of ammonia fertilizer and would be a great assistance to the government in their program of increasing agricultural enterprise in the country. In each of the above industries, the raw materials are available in the country and natural gas could be made available for fuel and raw material.

Other than the petroleum industry, much of the industry in Venezuela is grouped around Caracas although a number of industries are located in and around the cities of Maracay and Valencia. With the advent of natural gas to the region, the Valencia and Maracay area should find considerable favor for the establishment of industry. These cities are not too distant from Puerto Cabello and are located near the source of several mineral and agricultural raw materials. The area around Puerto Cabello itself would furnish an excellent site for the establishment of industry and if sufficient market were developed in this location, the natural-gas-transmission system could easily be extended to this port.

One of the most promising areas for industrial development in Venezuela is the Puerto La Cruz area. This area is close to adequate natural-gas reserves which can be delivered by a short transmission system. The topography of Puerto La Cruz is favorable to the development of a commodious seaport. Raw materials such as limestone from Pertigalete, magnesite from Santa Margarita, clays, and sands of various qualities can all be obtained by short hauls if not available where the industry prefers to build its plant. There are already two oil refineries in the area. With all of these advantages, Puerto La Cruz might well become a major industrial center.

With the announcement of the impending development of the huge iron-ore deposits south of the Orinoco River in the vicinity of Ciudad Bolivar, and the corollary development of the Orinoco as a commercial waterway, the area around Ciudad Bolivar and the other sections of the river may well see the development of industrial and commercial enterprises. Here again, natural-gas reserves are available within economical transporting distance to supply fuel and raw material.

The main competition to the sale of natural gas in Venezuela will come from fuel and diesel oil. Heavy oil is priced considerably below Gulf Coast market prices at coastal points of Venezuela, although the Creole and Shell companies have recently

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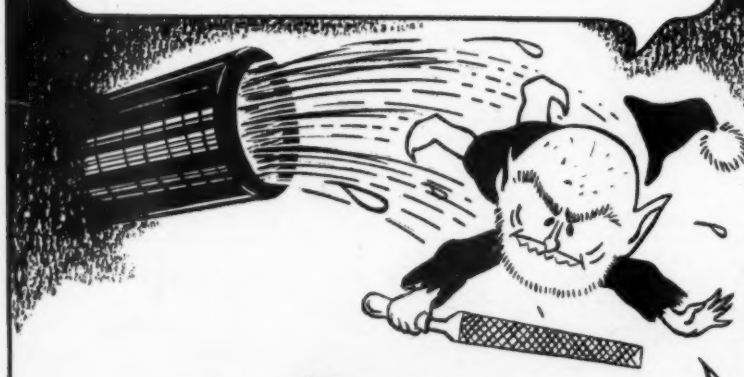

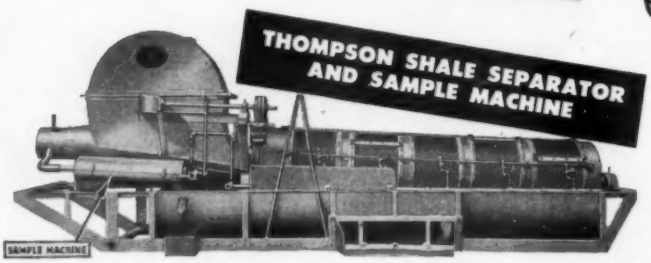

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announced an increase in price. The low cost of fuel oil at coastal points in the country is often more than doubled at interior locations (which will be served by the natural-gas system) because of expensive and inadequate transportation facilities. The installation of the natural-gas system will overcome these difficulties and make available to the industries of Venezuela a steady supply of uniform quality fuel at a long term contracted price. The establishment of a market for natural gas will offer an incentive for conserving this valuable commodity and should not adversely affect the markets for oil which are world wide.

Venezuela has been for many years and should continue to be a very wealthy country. It is one of the few nations of the world that has neither internal nor external debt. Annual governmental surpluses are customary and exhaustive efforts and expenditures are now being made to improve and modernize the country and develop its industry and agriculture. American capital, engineering and managerial abilities are invited and encouraged in this country as evidenced by the successful government-industry cooperation in the twentieth century development of American, British, and Dutch oil companies in the country.

Natural gas by the millions of cubic feet is now being flared in the oil fields of Venezuela. Huge reserves of gas adequate for the demands of many years are already proven in these areas. Detailed inspection of the market areas indicates large existing and potential industrial, domestic and commercial gas markets. These markets are eager to obtain this excellent fuel and national and local governments are encouraging the development of the natural gas industry.

The natural-gas pipe line from Venezuelan Atlantic Refining Co.'s Placer field to Caracas, La Guaira, Maracay, and Valencia will soon be an established reality and the first step in the development of a natural-gas-transmission system to serve all the major markets of Venezuela. Inasmuch as Venezuela is rapidly growing in wealth, population, and industry, the ultimate development of this project should be of considerable magnitude.

TABLE 1—NATURAL GAS RESERVES, PRODUCTION AND UTILIZATION IN VENEZUELA

(Millions of cubic feet)

Natural gas reserves in Venezuela (Dec. 31, 1949)		17,595,000
Natural-gas prod. (1949)		496,700
Utilization of gas production (1949):		
Fuel for camp, pumps, drilling	36,600	
Pressure maintenance and repressuring	35,500	
Sold for distribution	1,900	
Total utilization		74,000
Flared to the atmosphere		422,700

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A shooting station on the Cano La Brea in Creole's Guanoco concession, eastern Venezuela.

In heart of swamp, Guanoco concession, geophones were set up on stakes driven into swamp bottom.

Creole to Test Its Guanoco Concession

Will seek production downdip from asphalt seep

In this article, especially prepared for the Journal's Annual International Issue by technical personnel of Creole Petroleum Corp., are described some of the problems involved in exploratory operations in the Guanoco area of Venezuela. A wildcat well has been scheduled for the Guanoco area by Creole. This test is Creole's first on its 68,000-acre Guanoco concession.

Index map of northeastern Venezuela.

CREOLE PETROLEUM CORP. is planning to climax a major exploratory effort in eastern Venezuela when it spuds its new wildcat, 1 Guanoco. With this well, Creole, which is the Venezuelan affiliate of Standard Oil Co. (N. J.), will seek production downdip from the asphalt seep forming the famous Guanoco asphalt lake, around which Creole has a concession of approximately 68,000 acres.

This extensive deposit of asphalt—the world's largest—has an area of about 1,100 acres and an average depth of 6 ft. The New York & Bermudez Co., a subsidiary of the General Asphalt Co., of Philadelphia, very early obtained a concession to exploit the deposit. Between 1891 and 1935, when operations closed down, some 1,263,439 long tons of asphalt had been mined. This amounted to about 300 acres of the deposit. Active seeps of viscous asphaltic oil are gradually refilling the lake. The company constructed a camp and dock facilities at Guanoco village, the loading terminal on the Rio Guanoco, as well as a railroad from the dock to the asphalt lake.

The deposit is actually the residue of heavy asphaltic oil which has seeped to the surface over a long period of time and from which the more volatile constituents have evaporated. One estimate is that about 62,000,000

The channel or "pica" cut through Cano La Brea in the heart of the Guanoco.

This view of the Guanoco shows the channel cleared for passage of seismograph crews.

bbl. of oil were needed to provide the quantity of asphalt present.

Guanoco Discovery Well

Considerable previous drilling has been done in the area with limited success. On August 12, 1912, the New York & Bermudez Co. spudded its 1 Bababui, which proved to be the discovery well for Guanoco field. A production of 400 bbl. per day was secured on completion August 15, 1913, from the interval 300-615 ft. During the next 17 years the company drilled 40 or more wells along the Guanoco anticlinal axis. (Only a few of the wells are indicated on the maps.) Many of the wells were geological tests; however, flows of 100-1,200 bbl. per day per well of very heavy oil were secured from 18 wells drilled for Cretaceous production. The oil is asphaltic and has a gravity of 8° A.P.I., so heavy that the company was obliged to heat it to 317° F. in order to get it to flow through a pipe line. About 200 acres were proven by this drilling. By 1932, when operations were stopped, 1,854,139 bbl. had been produced.

The New York & Bermudez Co. wells ranged in depth from 55 to 4,247 ft. Two producing horizons were found.

Standard Oil Co. of Venezuela (now Creole) began its subsurface evaluation of this general area—described as the northern shore line of the Maturin basin—September 7, 1925, when it spudded 1 Sucax. This well was located 2½ km. southeast of the center of the asphalt lake, down dip from that seep, with accumulation in the Tertiaries and Cretaceous as the objective. Although no commercial production was obtained, there were a few shows of oil and gas, and numerous traces of asphalt in the well. The well was abandoned June 20, 1927.

On January 26, 1926, S.O.V.'s second well, 1 Sucek, was spudded 6 km. northeast of the asphalt lake. The well was drilled to a total depth of 2,450 ft. A few gas shows were noted, but the well was abandoned as a dry hole November 11, 1927.

Wildcat 1 Morrocoy was drilled in 1934 on a caño (river) about 25 km. northeast of the asphalt lake. Only slight shows were reported. Next year 2 Morrocoy, 8½ km. to the northwest, was drilled. Only a slight show of heavy oil was reported and, like 1 Morrocoy, it was abandoned. Of the two wells, only 1 Morrocoy appears on the Area de Guanoco map.

Further exploration was carried out on the north side of the Maturin basin where, at distances of from 4 to 9 km. southwest of Guanoco village, wildcats 1, 2, and 3 San Juan were drilled in the period 1934 to 1937. Slight shows of gas and oil were reported in all three, although no commercial production was found. The 1 San Juan flowed an estimated 50,000-100,000 bbl. of brackish water per day from 3,480 ft.

Exploration in Guanoco Area

In 1946, Creole sent a gravity-meter exploration crew into the Guanoco area, to supplement the earlier refraction seismograph work done in 1931 and 1932. Reflection seismograph surveys were carried out in 1948-1949.

Flowing through the center of the area in a southeasterly direction is the Caño La Brea. To the northwest are the foothills of the Coast Range Mountains, which terminate abruptly at a tidal swamp in the vicinity of Guanoco village. This swamp extends from the Guanoco River to the mouth of the San Juan River and the Gulf of Paria, and includes practically all the area covered by the gravity survey.

The swamp land is low enough to be flooded by the waters of the San Juan River Valley and to be subjected to the tides which pour into the San Juan River and its tributaries from the Gulf of Paria. This lowland is the eastern extension of the flat plains or "llanos" which border the foothill belt to the northwest. In the Guanoco region these plains are swampy because of the close proximity of the tidal rivers. It is necessary in this area to live on or near the water, as that is the only means of transportation available.

During the time the gravity crew was in operation (from November 1946 to May 1947) the entire area was covered with mud and the greater part of it by water, twice daily at high tide. The waterways are bounded by vines and trees which form thickly wooded strips, about 2 km. in width, along the banks of the rivers. The trees include the "mangle," "sangrilla," "leche," "espina," "reveno" and many others. During the rainy season shallow lagoons, about 10 cm. in depth, are formed in the area. These are covered with vines, tough swamp grass about 2 m. high, and scattered palm trees.

In the dry season the lagoons disappear, leaving in their place large areas which very much resemble savanna country but which actually consist of floating soil held together by the vegetation. These areas are very treacherous, the ground in parts being solid enough to withstand the weight of a man, while in others it is so soft that one may sink in it up

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to one's chest. These soft spots are locally referred to as "bombas" and they are anywhere from 1 to 200 m. in diameter.

In the course of this survey it was necessary to clear trails (picas) over the entire area, for the purpose of locating the lines of gravity stations, except where these lines fell along the waterways. The lagoon or marsh grass which dried out was burned making it possible to clear picas through it with a minimum of cutting. The mud and water in these picas served as a protection from the cutting edges of this grass. However, any exposed parts of the body were always in danger of being scratched and cut, as were the legs and feet of the laborers who ventured to work these picas in their sandals.

On the waterways the crew was continually molested by numerous insects such as the very troublesome "jejen," green horseflies and small stinging flies. Mosquitoes were numerous during the hours between sundown and daybreak. A moth which scatters a fine dust or powder caused some uncomfortable skin irritation. Many species of snakes, ranging from water snakes over 20 ft. long and the deadly bushmaster to the coral snake, are found in this area. The animals living in this area include tigers, wildcats and hogs, alligators, many kinds of monkey and deer.

The San Juan River, flowing from west to east along the southern boundary of the area, is the main waterway of the region. This river reaches a depth of 107 ft. To the west is the Guanoco River, which is roughly 10 km. long and flows southward into the San Juan. About 6 km. upstream from the junction of the two rivers, on the west bank of the Guanoco River, is the village of Guanoco, which is accessible by water via the Gulf of Paria and the San Juan and Guanoco rivers.

Ships of 5,000 tons can reach the Guanoco wharf at high tide. Flowing to the south and east through the east-central part of the area, is the Caño La Brea, which has a minimum depth of 15 ft. About 9 km. downstream from its origin the Caño La Brea is joined by its tributary, the Caño Breita. This last-mentioned stream flows eastward for about half its length and then northward into the Caño La Brea. The average width of Caño La Brea is about 100 ft., but it may range from 80 to around 150 ft. Caño Breita is covered with a dense growth of moss and filled with fallen trees and for the most part is passable only in dugout canoes ("curiaras").

Apart from those already mentioned, numerous other smaller caños are present throughout the area. It is possible at high tide to travel as much as 4 km. upstream in these by canoes. At low tide these small caños have no water.

The climate does not vary greatly throughout the year. Heavy rains fall during the wet season from June to December. The humidity is uncomfortably high during this period. The annual rainfall is about 100 in.

The gravity-meter information obtained throughout the Guanoco concession was followed by obtaining structural control from seismic data. The seismic results were considered essential before locating any test wells.

The only village in the area is Guanoco. It has an estimated population of several hundred. Guanoco village lies on the north bank of the Rio Guanoco about 5 km. north-northeast of its mouth on the Rio San Juan. It is about 3 km. west of the Guanoco concessions and 9 km. southeast of the asphalt lake, with which it was connected by a railroad track. This track was built on fill above the swamp and once was used for transporting asphalt from the lake to a loading dock on the Rio Guanoco. It has since been mostly removed, although the roadbed is still above the surface of the swamp.

In late 1949 work was started on an access road to a proposed wildcat location about 6 km. southeast of the asphalt lake. This road follows the old railroad fill about 3½ km. northeast of Guanoco village. At this point, 250 m. northeast of the old railroad bridge across a caño, the new road bears about 8.65° E. for 7.6 km. to the vicinity of the wildcat location. The road is for the most part in the woods. Here a surface layer of decaying vegetable matter and humus 2 m. thick overlies a very soft, high-liquid-content clay, which extends down 20 or 30 m. In the open savannah, this surface layer is 4 to 6 m. thick. Shale obtained from a low ridge near the old railroad track was used as fill. In the savannah, the fill was dumped on a mat of logs in order to prevent excessive settlement.

A Creole crew will be used to drill the new wildcat and equipment is now being moved to the site. Projection of the probable depth of the well does not exceed 8,000 ft.

Capital Is Increased

Anglo-American Oil Co., Ltd., has increased its capital as a step in financing construction now under way on the new 126,000-bbl. daily capacity at Fawley near Southampton in Great Britain.

The company is controlled by Standard Oil Co. (N. J.). Estimates now place cost of the Fawley refinery at £37,500,000, or about $95,000,000 at current exchange rates. The plant, scheduled for completion before the end of next year, will be the largest in Europe. Anglo-American's capital increase is from £12,500,000 to £20,000,000, and any shares which may be issued will be taken by existing shareholders.

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Astute, efficiency-minded J. A. Henby, Vice President in charge of Production, checks on location of new equipment.

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John Ochs, forceful, energetic Superintendent, Fittings Forging Dept., smiles over another production record.

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SGHP's New Dunkirk Refinery

by J. Andrault*

New plant replaces two which were wrecked during the war. Commissioning is scheduled for late 1951

THE Societe Generale des Huiles de Petrole is now constructing a new modern refinery at Dunkirk, France.

In the first stage of the program this refinery has, since early 1950, been processing crude oil at the rate of 450,000 tons per year. The new installations in course of construction will bring the capacity of the refinery up to 1,400,000 tons, with a production of 55,000 tons of lubricating oil per year. Commissioning of the new installations is planned for the end of 1951.

The new Dunkirk refinery replaces two refineries in the north of France which were wrecked in the course of the war. These plants are the Courchelettes refinery of SGHP and the old Dunkirk refinery which belonged to the Raffinerie de Petrole du Nord.

The Courchelettes refinery sustained extensive damage during violent bombardments in 1944. The old Dunkirk refinery, in which the storage tanks were destroyed by bombardments in 1940, was systematically dismantled by the Germans in 1943 and the process units were taken to Germany. All which could be reutilized, such as piping, pumps, cables, electric gear, motors, compressors, and turbo-alternators were also taken away. In fact, at the end of the war, little was left on the refinery site but a few damaged buildings.

*Chief engineer, Societe Generale des Huiles de Petrole.

Fig. 1—One of the pipe lines used to supply sand for filling in part of the site of the new Dunkirk, France, refinery of Societe des Huiles de Petrole.

In 1947, on the recommendation of the French Government, SGHP and RPN negotiated a mutual agreement whereby a single large refinery would be reconstructed at Dunkirk by SGHP. This decision, at a time when the scarcity of steel was a dominant factor, satisfied the needs of the refining companies for considerable refining capacity to meet future requirements.

Reconstruction of the Dunkirk Refinery

Preparation of the site.—The new Dunkirk plant is being built on the site of the old refinery, that, is on made ground situated on the border

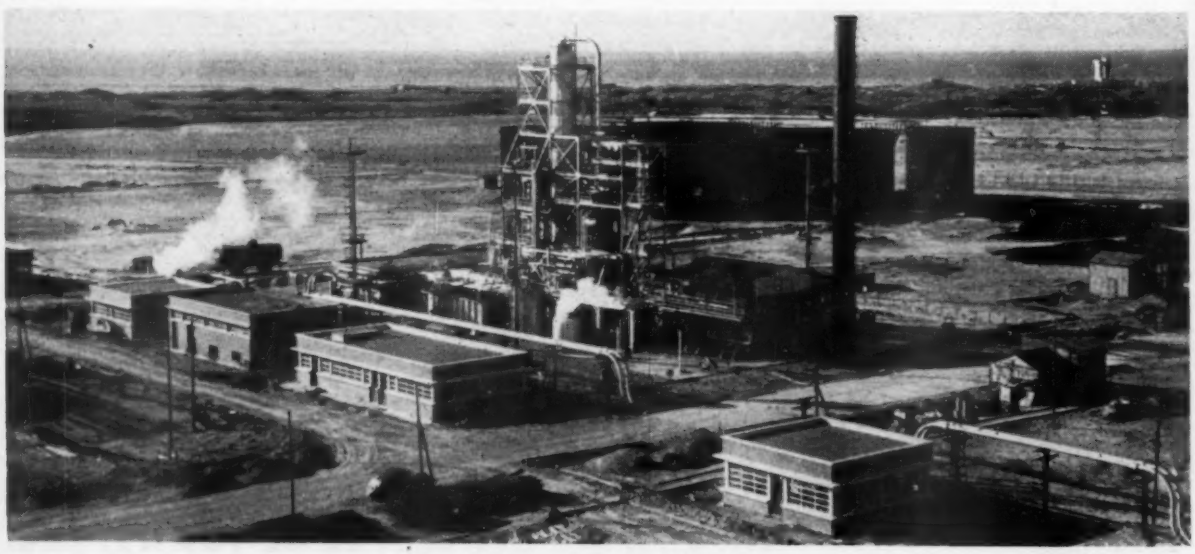


Fig. 2—The new topping unit at Dunkirk.

and to the west of the port of Dunkirk. The new installations have an area of 250 acres, about three times that of the old refinery. The area is divided into three zones: (1) refining, (2) storage area, and (3) intermediary zone connecting the first two.

Preparation of the marshy ground newly acquired has raised problems of filling and draining. It was decided that the natural ground level should be raised by about 11 ft. For this it would be necessary to use about 1.5 million cubic yards of sand, but such a quantity could not be found, even at a considerable distance from the refinery. The solution adopted was to discharge into the zones to be raised the sand which the harbor authorities had to dredge from the port of Dunkirk. The sand diluted with a large quantity of water (8 to 10 parts of water to 1 part of sand) was pumped for distances of more than a mile through 24-in. pipe lines. The sand immediately settled and the water returned to the sea by a ditch system ending with an outlet canal to the beach.

About 1.7 million cubic yards of sand have in this way been put into place at the rate of 4,000 cu. yd. per day (Fig. 1). The ground allocated to the storage area had to be drained by a complete system, the very small fall of which rendered the work difficult. The removal of the remains of the old refinery foundations, piles, trenches, and sewers, as well as the demolition of the old buildings, too damaged to be reconstructed, necessitated the extensive use of explosives as well as the services of numerous mechanical machines such as bulldozers, turnapulls, scrapers, and draglines. To these difficulties should be added the risk of bombs and mines, over 200 of which were found on the site; several exploded, fortunately, with material damage only.

Construction program. — Owing to the extent of the program, the general construction work was divided into two stages. The first stage consisted in reerecting at Dunkirk, with all necessary services and auxiliaries, a 7,500-bbl. per stream day topping unit which had been installed in 1938 at Courchelettes by M. W. Kellogg Co. This stage also included the construction of tanks of a capacity of about 1,000,000 bbl. which would be used for operation of the topping unit as well as forming a depot for oil products from other sources.

Work began in November 1948 and the commissioning of the topping unit took place in February 1950. This unit since then has been processing up to 1,400 tons of crude oil per day. During the second and last stage, the completion of which is expected by the end of 1951, the treating capacity of the new refinery will be brought up to 1,400,000 tons per year of Middle East crude. The new units, description of which follows, will be able to produce all the gasolines and fuels as well as asphalt and cutbacks and 55,000 tons of lubricating oil required by the market.

Fig. 3—Part of the 1,000,000 bbl. of new tankage installed at Dunkirk.

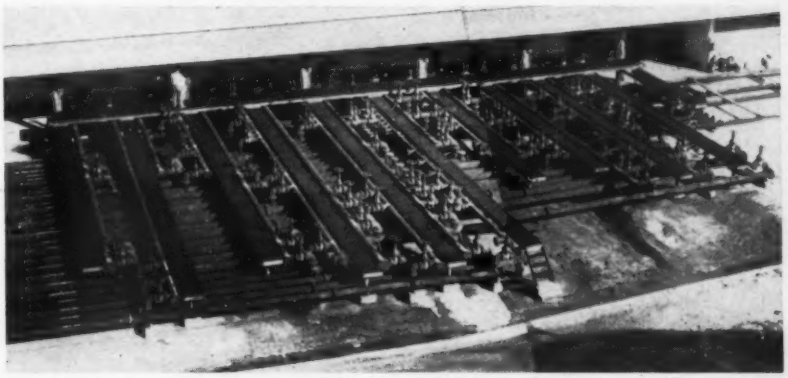


Fig. 4—Manifold erected at the new plant of Societe des Huiles de Petrole.

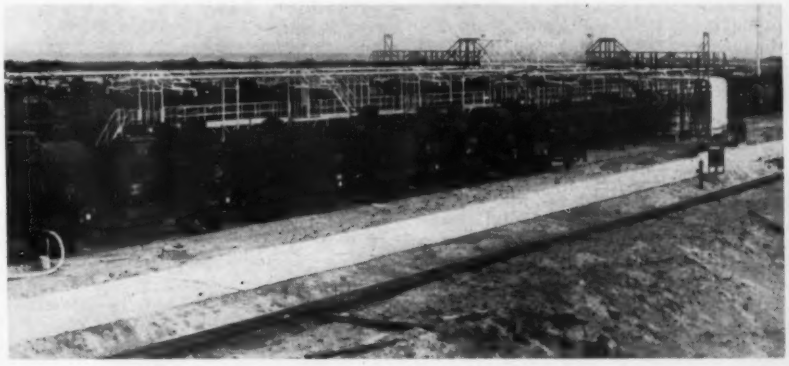


Fig. 5—A section of the loading rack at the Dunkirk refinery.

Plans call for the manufacture of the following:

Products—	Thousand tons/year
L.P.G. (C_3 and C_4)	21.5
Gasolines	311.5
Kerosines and solvents	12
Motor gas oil	129
Domestic fuel oil	91
Light fuel oil	90
Heavy fuel (1 and 2)	358
Lubricating oil	55
Wax	12
Various bitumens	137

The general planning and layout of the new refinery as well as the general services, storage, linkup piping, and dispatching facilities have been developed by SGHP in collaboration with the technical services of Anglo-Iranian Oil Co., Ltd. Design and erection of the new distillation units, the chemical treatment of the spirit, fabrication of lube oil and asphalt, has been entrusted to Lummus Co. The naphtha reformer is being designed by M. W. Kellogg Co. which also supervises its erection.

Tankers at present come alongside the quay in one of the docks of the port of Dunkirk. An unloading station has been arranged for this purpose. It is connected to the refinery

by two pipe lines of 8 and 10-in about 1.4 miles long; 350 tons per hour are unloaded. For the first stage, SGHP is constructing in the turning basin of the port of Dunkirk a jetty which will permit the simultaneous reception of two tankers of the heaviest tonnage, the depth always exceeding 37 ft. This item is in course of achievement and will start operating at the beginning of 1951. It includes two unloading points with pipe lines to the refinery. The crude-oil pipe lines, 1.8 miles long, are designed to unload tankers at over 1,200 tons per hour; 16 large-diameter lines connect the wharf to the refinery for the shipment by sea of all grades of products. This installation is equipped with all the modern arrangements for security and the safety of the operating personnel.

At present the operating units at Dunkirk include:

1. An atmospheric distillation unit of 7,500 bbl. per stream day transferred from the Courchelettes refinery. This unit has been modernized and include, in particular, a new stabilization tower and an additional gas-oil drawoff (Fig. 2). A throughput of 8,800 bbl. daily is now being achieved.

2. A caustic soda treating unit for gasoline.

3. A doctor treater for gasoline.

4. A TEL unit for gasoline. This unit, designed straight away for the second stage, permits the reception of TEL fluid in barrels and also in bulk by tank wagons.

As this first stage does not include a reforming unit, the kerosine is sent to a hydrogenation plant some 30 miles away where it is processed into gasoline (O.N. 70 clear). This gasoline is then returned to the Dunkirk refinery where it is blended with straightrun gasoline to form motor fuel. The units in the final stage, which are of modern design, are under construction. All the civil engineering is completed and the equipment is being erected. Some of these new units will start operating in March 1951, i.e., the installation of the copper chloride treatment and the solvent redistillation unit and acid wash plant. Commissioning of the other units will be spreading over the last part of 1951.

The new installations which Lummus is at present erecting are:

1. An atmospheric vacuum distillation unit (26,000 and 9,000 bbl. per stream day) which will supply on the atmospheric side six different distillate cuts and on the vacuum side, five cuts.

2. A solvent redistillation unit (200 bbl. per stream day) which will supply the entire range of light solvents required by the market.

3. A double unit copper chloride treatment of gasoline (6,000 bbl. per stream day each).

4. A unit for the preparation of emulsifiable road asphalts, cutbacks, industrial asphalt (1,100 bbl. per stream day cutbacks and 1,300 bbl. per stream day emulsifiable grades).

The lubricating-oil plant is designed for a yearly production of 55,000 tons of high-grade oil per year. It employs the latest processes consisting of:

1. A propane deasphalting unit.
2. A furfural extraction unit.
3. A M.E.K. solvent-dewaxing unit.
4. A clay contact unit.
5. A hot-oil circulating system, installed near the lube-oil plant to circulate hot gas oil for supplying heat to various units.

Sections of the project handled by M. W. Kellogg Co. are:

1. A 6,000-bbl. per stream day naphtha-reforming unit.

SGHP engineers are designing and erecting facilities for:

1. Separation and treating of the butane and propane.
2. Caustic soda and chemical treatment of light solvents and kerosine.
3. Bitumen barreling.
4. Wax treatment and packing.
5. Disposal of waste products.

Storage capacity actually in service is about 1,000,000 bbl. (Fig. 3). There are two modern pump houses, one for white products, the other for black products (Fig. 4).

Tank capacity will reach 3,150,000 bbl. by the end of construction including intermediate storage. It should be noted that eight tanks of 126,000 bbl. each are allocated to crude oil.

Transportation

For the present stage, the refinery has ample dispatching facilities. A marshaling yard containing over 10 miles of track permits the shunting and loading of 150 trucks per day. The railway siding is connected to the French national railway system (SNCF) by the private branch line.

The rail system serves:

1. A loading gantry for black products comprising 16 loading points which can work simultaneously (Fig. 5).

2. A similar gantry for white products.

In the final stage, will be added:

1. A gantry for loading lube oils having eight loading points (already constructed).

2. A loading point for solvents.

3. A loading point for butane and propane.

4. A loading point for asphalt.

5. Platforms for loading asphalt in barrels and for handling wax in cakes.

The old refinery was already connected to the navigable canal system by a connecting channel from the loading dock. These facilities still exist and allow the reception and dispatch of six barges per day at two loading stations.

Dispatching by sea has not been provided for in the first stage, but in a few months the refinery will have adequate facilities. The connecting pipe lines to the tanker jetty are in course of construction.

Two loading stations, one for the black products and the other for the white products are in course of achievement. The first will be able to load three tankers simultaneously and the second, four.

The refinery is connected by four 8-in. pipe lines, over a mile long, to a distribution depot which serves several petroleum companies.

General Services

Steam.—For working the refinery during the first stage, the boiler installation of the old plant, which was heavily damaged during the war, has been repaired. It is thus that three boilers, each with a capacity of 15 tons per hour of steam and a rating of 400 psi., have been put into operation. These boilers feed a passout and condensing turbine which provides steam at 56 psi. The steam is distributed in the refinery at 210 psi. for pumps, etc., and at 56 psi. for heating and topping-unit process steam.

A new and larger boiler house for the final stage is in course of construction. It will contain two Babcock & Wilcox modern boilers of 50-60 tons per hour, 485° C. rated at 920 psi., heated by gas or fuel oil. These boilers will feed into two new passout and back-pressure turbines which will provide steam at 210° and 56 psi. The auxiliaries have been specially designed to insure continuity of steam supply to the refinery. The feed water for the boilers is treated by double permutation. A silica-removal process will be added for Stage 2.

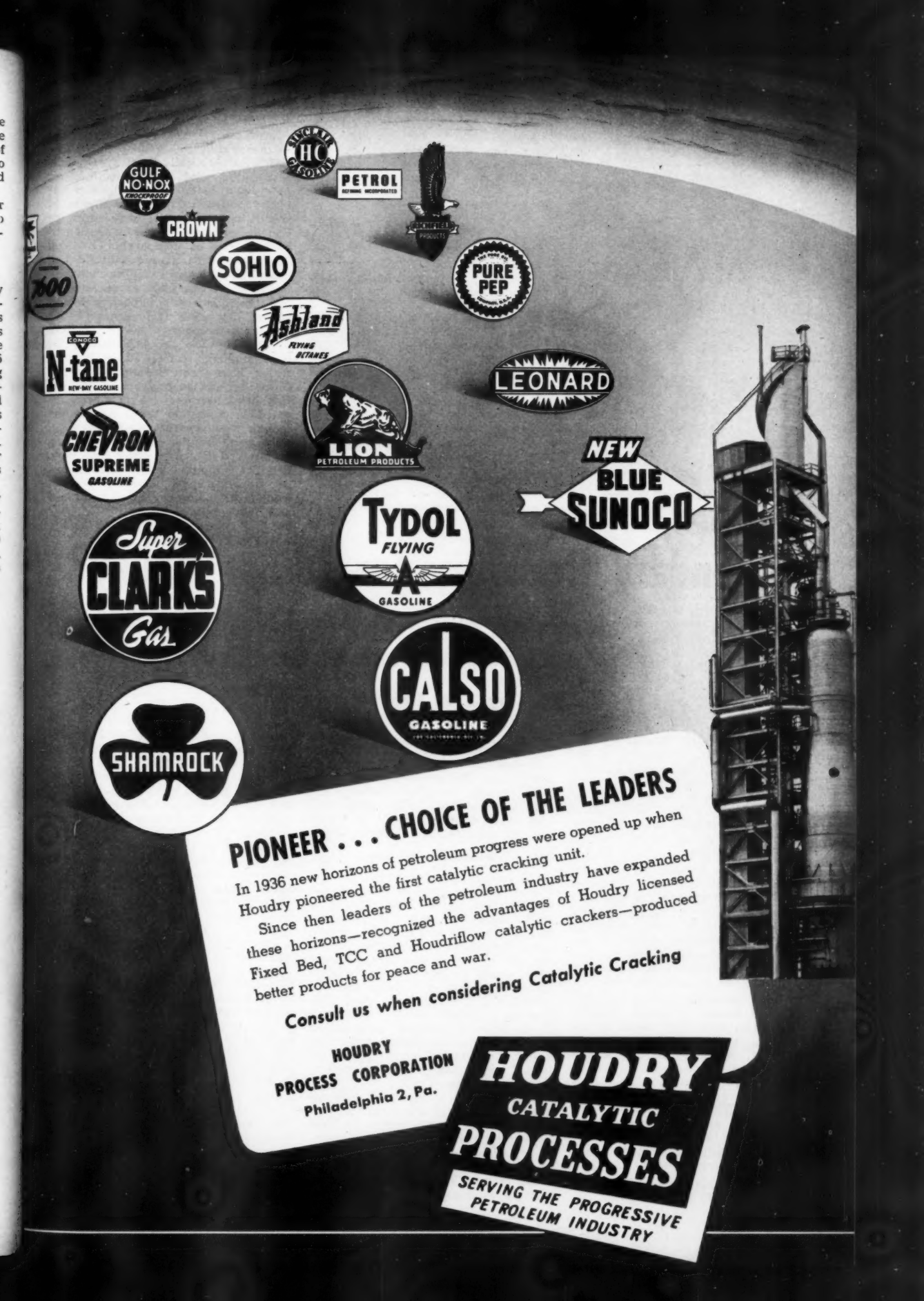
Electricity.—The present turbine drives a 1,600-kva. 3,000-volt alternator. Power is distributed at 3,000 volts to the substations where it is then transformed into 380 volts. The big motors in the refinery are supplied direct from the substations at 3,000 volts. In the final stage, two new alternators each of 6,200 kva. at 3,000 volts will be driven by the two new turbines mentioned above. In addition, the peak loads and standby supply will be obtained from the national grid. Nine substations are located in the refinery, the storage areas, and other sections of the area.

Compressed air.—A station comprising four compressors is in course of construction. The compressed air will be distributed in refinery at 115 psi.

Cooling water.—A large pumping station (2,500,000 gal. per hour installed) delivers sea water into the distribution network. The water is taken from the turning basin of the port and is led to the pumping station by a syphon of 60-in. diameter and 330 yd. long.

Other services under construction:

1. An extensive sewer system which terminates in an A.P.I.-type separator.
2. A fresh-water network.
3. A water network for firefighting.
4. A telephone and fire-alarm network.
5. A gas and fuel-oil network.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SERVING THE PROGRESSIVE PETROLEUM INDUSTRY

Royalite's Turner Valley field manager, E. F. T. Stevens, and J. A. Harvie, district petroleum engineer, who is author of this article, discuss a water-injection experiment.

Owing to the low indicated recovery of oil by primary methods from Turner Valley field, Royalite Oil Co., Ltd., Turner Valley, Alta., Canada, initiated a pilot water-injection test in August 1948. Water injection has been applied to numerous fields in the United States, but to the author's knowledge it has not been applied to a limestone of comparable texture. The experiment is unique in this regard. The permeability is both low and irregular. It was fully appreciated at the time that this experiment was started that many factors were either unknown, or pointed to the possible failure of such an experiment. To date slightly over 1,180,000 bbl. of water have been injected into the formation and an increase in production has been obtained on a well located ¼ mile due north of the injection well. Another well located ½ mile north of the injected well has maintained its production rate over the last 6 months rather than showing a decline as is customary. The experiment is being continued to obtain additional data.

Secondary Recovery for Turner Valley?

Despite lack of reservoir data, engineers felt a field trial of possibilities, with water-injection methods, was warranted

by J. A. Harvie*

THE Turner Valley structure is situated 30 miles southwest of the city of Calgary, Alta., about 20 miles from the first range of the Rocky Mountains, being in the outer part of the foothills belt. The field is about 25 miles long striking about 20° west of north and has a width varying from ½ to 3 miles.

The structure consists of a steeply overturned anticline in a faulted thrust block bounded on the east by a major sole fault. A highly faulted easterly overthrust cuts obliquely across the northward plunge of the main structure resulting in a great complexity of structure at this end of the field.

Production comes almost entirely from a Paleozoic limestone (Rundle or Madison) with total depth of the producing wells varying from 3,792 to 9,612 ft. Normally about a 450-ft. section of limestone is drilled and in this are found two porous zones having an average total thickness of about 145 ft. The lower zone is poorly developed or missing in the central portion of the field. A gas cap of approximately 15 miles in length and 1 mile in width is situated on the highest part of the structure, being on the east side of the producing area, and has an area of approximately 9,000 acres. The crude-oil area to the west of and downdip from the gas cap is approximately 25 miles long and from ½ to 1¾ miles in width with an area of about 17,000 acres.

*District Petroleum Engineer, Royalite Oil Co., Ltd., Turner Valley, Alta.

Production History

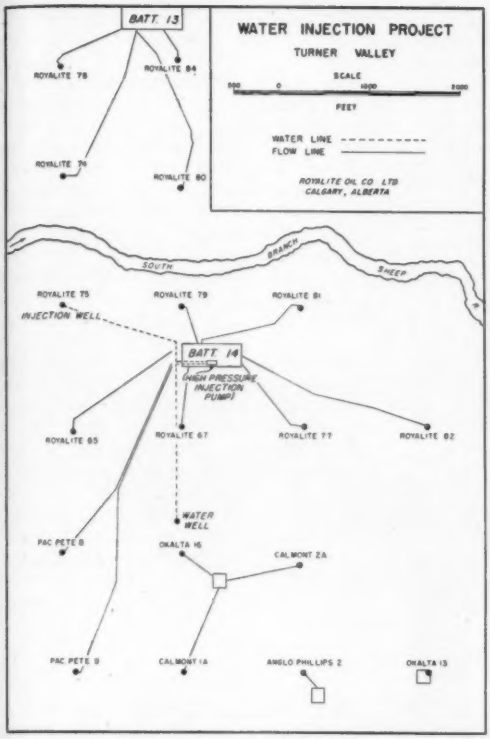
Oil was first discovered in the Turner Valley area in 1914 at the Calgary Petroleum Products No. 1 well (sometimes called 1 Dingman and later known as 1 Royalite) where a small quantity of high-grade crude was obtained from the Lower Cretaceous sands. In 1924, 4 Royalite blew in with 600 bbl. of naphtha and 20,000,000 cu. ft. of gas per day. This was the discovery well in the gas cap of the Rundle limestone. Exploration of the gas cap continued under the impetus of market demand and by 1930, 75 wells had been completed in the gas-cap area.

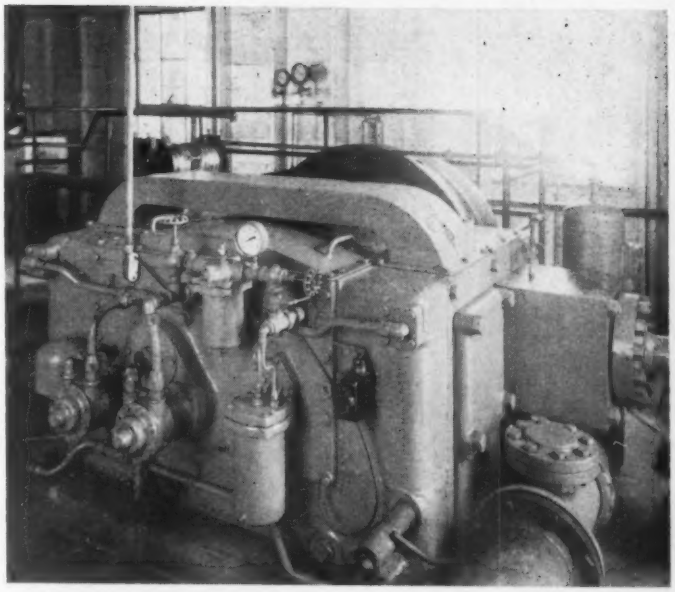
Existence of a crude-oil reserve down the flank of the structure was demonstrated in 1936 wthen the first large producer of crude oil, 1 Turner Valley Royalties, was completed, with an initial production of 850 bbl. of crude oil and 2,000,000 cu. ft. of gas per day. Active drilling for crude oil has continued up to the present and at the end of 1949, 395 wells were being operated in the Turner Valley limestone pool of which 97 were classified as gas-cap wells producing 30,000 cu. ft. or more of gas for each barrel of oil, and 298 were classified as crude-oil wells producing oil in ratios of 30,000 cu. ft. of gas or less per barrel. In addition three wells were also completed as shallow crude wells, being completed in the sands above the Rundle limestone. Oil wells were drilled largely on a 40-acre spacing.

Crude oil in place in the reservoir has been estimated between 750 million and 1 billion barrels, of which 85 million barrels had been produced as of January 1, 1950. In addition, 9 million barrels of naphtha had also been recovered at this time. It has been estimated that primary methods of recovery (essentially gas in solution drive) might yield as much as 110 million barrels of crude oil.

Reservoir Problems

A detailed study was made by Royalite as to the possibilities of secondary recovery in Turner Valley field. The complexity of the structure, particularly in the north end of the field, which resulted in se-





Left: Layout of Royalite's Turner Valley water-injection project. Above: This high-pressure pumping unit is now delivering water to the Royalite input well at the rate of 1,600 bbl. daily.

vere faulting, was noted. Some evidence of minor faulting was also noted in the south end of the field. Although relatively little information was available on the permeability of the producing zones there was indicated a relatively impermeable section approximately in the geographic center of the producing limits of the field.

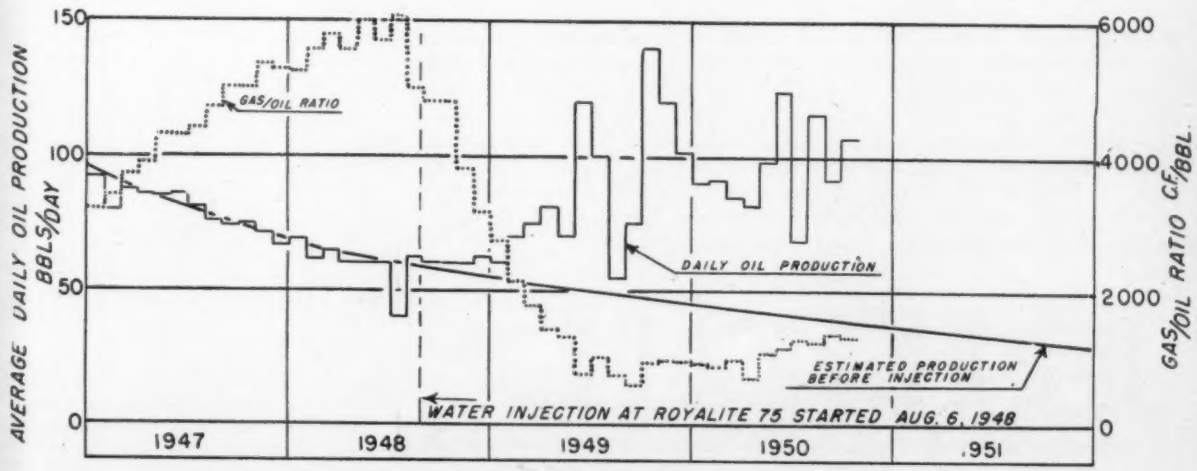
The impermeable section runs along the axis of the field, being approximately 7 miles in length and divides the field in half with oil wells on the west side and gas wells on the east. This barrier, it was felt, would limit migration of oil upstructure. Water-displacement tests run on two core samples were most encouraging. These tests indicated a flushing efficiency of from 79 to 92 per cent. However, core data were practically nil and conventional electric logs of the producing zones showed no contrast between permeable and impermeable sections. Reservoir pressure data were incomplete due to the long shut-in periods required before equalization with the reservoir pressure could be obtained.

It was felt that due to the large percentage of oil calculated to remain in the reservoir at the end of primary methods of recovery and despite the lack of reservoir data, a field trial of secondary recovery was warranted. A water flood appeared to offer the best possibilities.

Water-Injection Test

For the initial phase of the experiment, 75 Royalite was selected as the input well. This well is located on the west side of the oil-producing zone in approximately the center of the field, 2 miles southwest of the town of Turner Valley. This well was considered to be the most favorable for the initial test as it is located in the central area which is felt to be relatively free from faults and is also protected by the less permeable section as previously described. Royalite largely controls the acreage immediately surrounding the injection well. The few independent producers have indicated their willingness to cooperate in the water-flood test.

After some exploration, a water well was located in the vicinity of the injection well suitable to produce water in quantities large enough



Monthly production graph, 74 Royalite.

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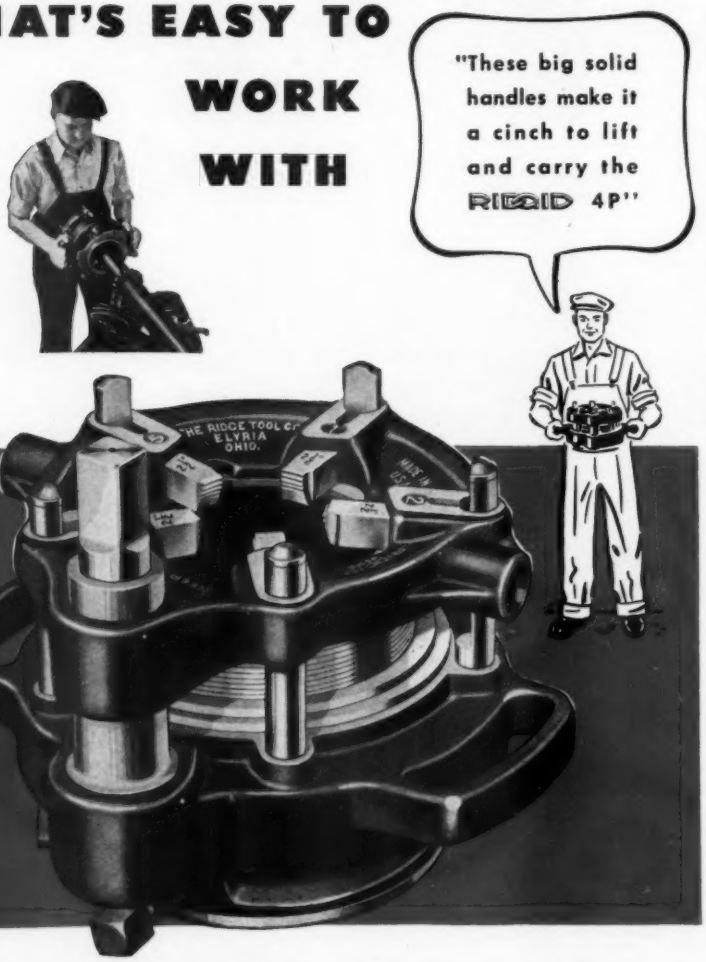

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for the initial test. This water was relatively free from minerals and the only treatment considered necessary prior to the injection was to lower the pH factor from 7.7 to 6.6 to minimize the precipitation of calcium carbonate which might plug the pores of the formation. River water, which is readily available, was not considered suitable for injection due to its high dissolved oxygen content. The water well was equipped with a 15-hp. motor and a deep-well pump with an operating capacity of 150 g.p.m. The well itself is capable of producing up to 6,000 bbl. of water per day.

Injection of water was initially started making use of a 125-hp. engine and a 3½ by 10-in. pump. This equipment was later changed due to the higher operating pressures desired to a 150-hp. engine and a high-pressure pump. To date some 1,180,000 bbl. of water have been injected with an average injection of 1,400 psi. Present operations are at a pressure of 1,850 psi. at which pressure 1,600 bbl. per day of water is being injected.

An attempt to heat the injection water and thus decrease its viscosity and increase the injection rate was made during 1948. No increase in the injection rate was noted but it is not felt that a fair trial has been carried out and future experiments along this line will undoubtedly be made. No plugging of the injection well has been noted to date.

The first well to show any effect of the water-injection experiment was 74 Royalite. This well lies in the legal subdivision north of the injection well. The first indication of any effect was a decrease in the gas-oil ratio which decreased from an average in July 1948 of 6,115 cu. ft. per barrel to an average of 949 cu. ft. per barrel in December 1949. Water made its appearance at this well during October 1949, and by October 1950 had increased to 28 per cent.

Oil production had increased from an average of 60 bbl. per day in June 1948 to slightly in excess of 100 bbl. per day as of January 1, 1950. Since that date production has been restricted to approximately 125 bbl. per day although the well appears to be capable of producing considerably more. Shut-in pressure tests also indicate some increase in both the 24-hour and reservoir pressures. The 78 Royalite, which lies ¼ mile to the north of 74 Royalite and ½ mile north of the injection well, has shown no decline in production rate over the past 6 months. The gas-oil ratio has remained steady and it may be that this well is being benefited to a small degree.

Engineers of Royalite and other interested companies are keeping a close watch on this experiment. Reservoir studies of the general water-flood area are in progress which it is hoped will assist in predicting future performances of the wells in the test area.

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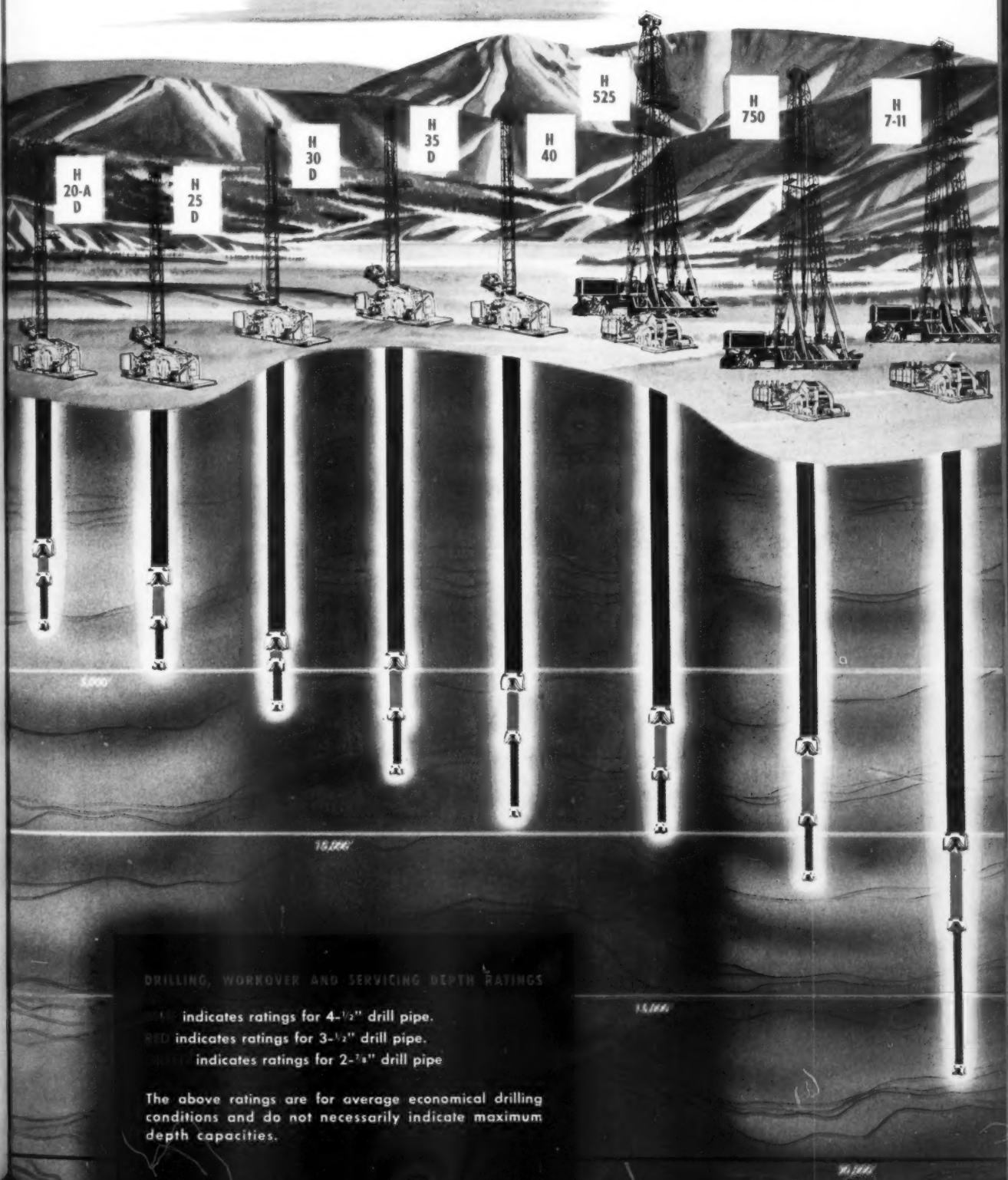

DRILLING, WORKOVER AND SERVICING DEPTH RATINGS

[illegible] indicates ratings for 4-½" drill pipe.
RED indicates ratings for 3-½" drill pipe.
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The above ratings are for average economical drilling conditions and do not necessarily indicate maximum depth capacities.

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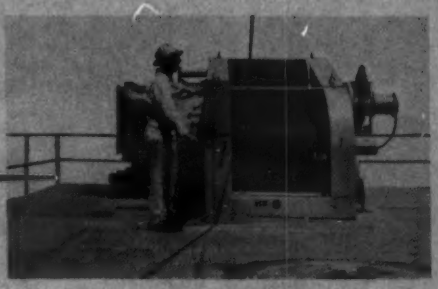

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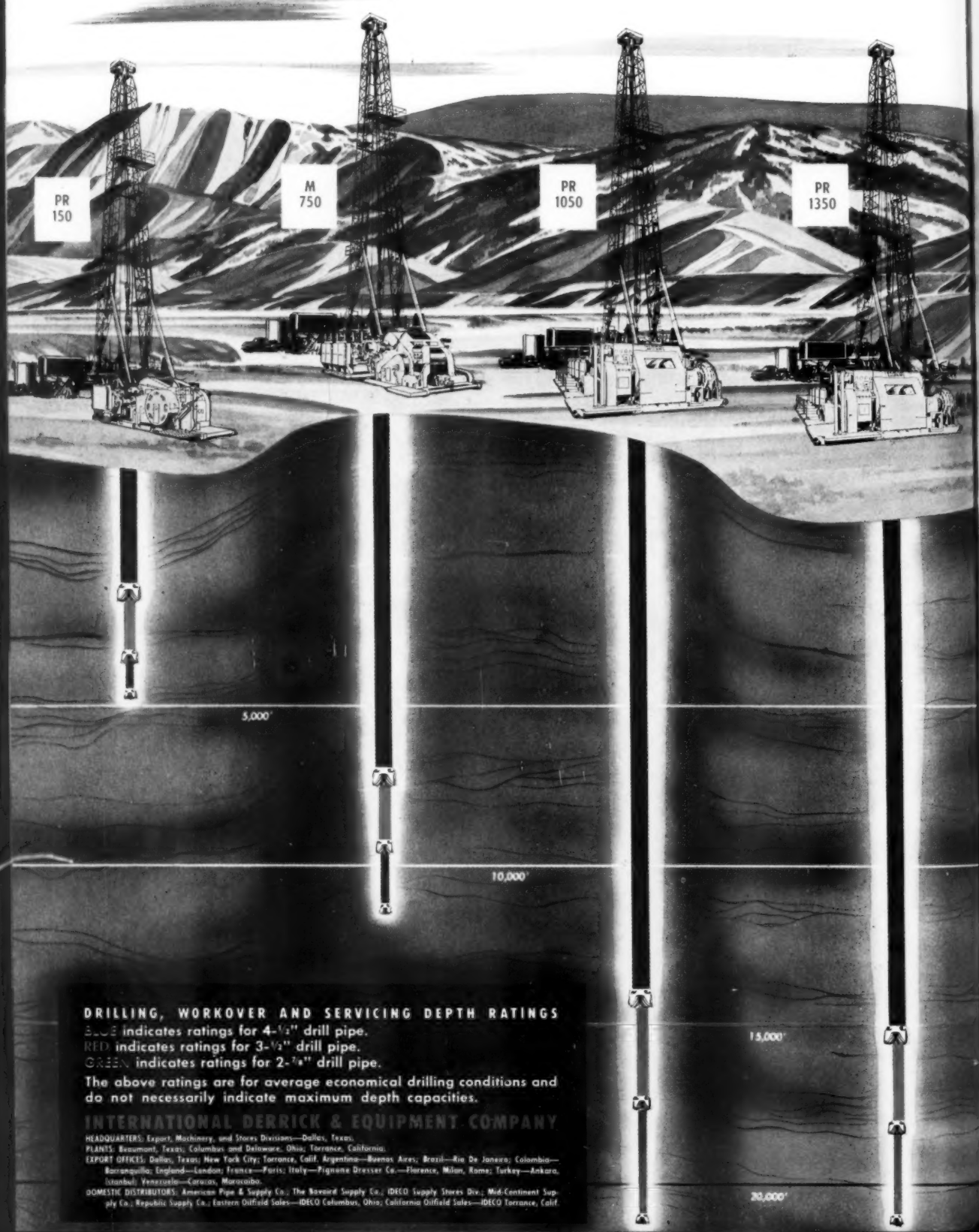

DRILLING, WORKOVER AND SERVICING DEPTH RATINGS

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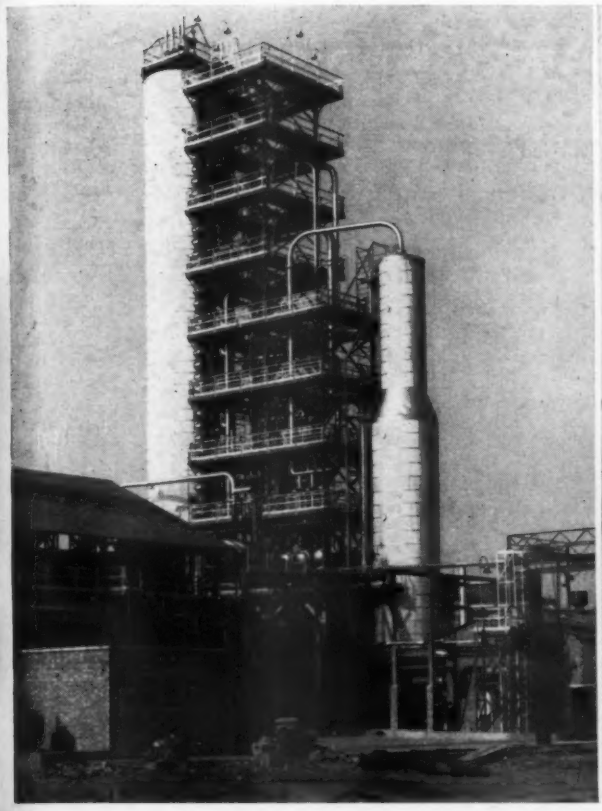
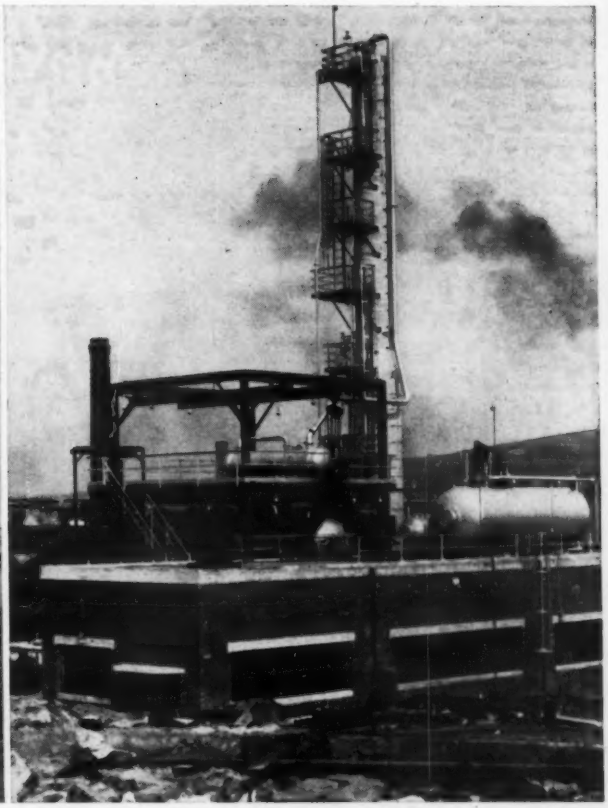


This modern atmospheric distillation unit, recently placed in operation at Llandarcy, is rated at 45,000 bbl. of crude oil daily.



Anglo-Iranian's new stabilizing plant. Other facilities at Llandarcy include a catalytic cracking unit, feed-preparation, and lube-oil units.

Anglo-Iranian's Llandarcy Refinery Expands

This article was prepared especially for the Journal's Annual International Number by technical personnel of Anglo-Iranian Oil Co., Ltd.

THE Llandarcy refinery of Anglo-Iranian Oil Co. is at present undergoing considerable expansion as part of a general postwar plan to increase refining capacity in the United Kingdom to about 20 million tons per annum.

The refinery, which is situated near the Port of Swansea in South Wales, was opened originally in 1921. From about 1931 to 1939 facilities existed for dealing with Middle East crude oil at the annual rate of 360,000 tons.

Crude oil from the Middle East is received at the Queen's Dock, Swansea, in tankers of 12,000 to 17,000-ton capacity, from where it is transferred by the ships' pumps to intermediate tankage at a transit site situated on the foreshore about 1 mile distant. From there high-pressure multistage electrically driven centrifugal pumps transfer the crude to the main storage tank farm some 3½ miles distant.

The original refinery, built during World War I, produced motor gasoline, kerosine, gas oil, residual fuel oil, together with some distillate lubricating oils and wax. The distillation plant was of the now obsolete shell-still type, and products were given such treatment as was necessary, in simple batch equipment.

From time to time, as more efficient distillation and treatment units were evolved, many of the older units were replaced. By 1939 the refinery contained equipment of up-to-date design, enabling a greater range of refined products including liquefied propane and butant, premium and regular grades of motor spirit, white spirit, kerosine, tractor vaporizing oil, several grades of gas oil, a full range of solvent-refined lubricating oils, various grades of wax, fuel oil, and bitumen.

Refinery Site

The refinery site, which covers about 800 acres, is undulating, and varies in level from 40 to 270 ft. above sea level. It was realized that extensive excavation would be required in leveling sites for the new plant and it was important to establish the depths at which rock would be encountered. A survey was therefore made of the main development area using an electrical resistance method coupled with some test borings, which confirmed the existence of rock close to the surface over most of the site. Borings on the site of the new crude-oil-distillation unit, however, revealed a very deep pocket of sloppy boulder clay and sand of very low bearing value which necessitated piling under heavy equipment.

Permissible bearing loads on foundations vary from half a ton to 5 tons per square foot, and have been arrived at by various methods including analysis of soil samples from borings, inspection of bottoms of trial pits, and carrying out of actual tests in doubtful cases.

Due to the layout of the original

refinery, which had to be kept in operation, and the undulating nature of the site, the layout presented particular difficulty, and the usual ideal arrangement of setting out the refinery with roads and pipe routes intersecting at right angles could not be followed. The ultimate layout developed for the new units was based on a series of terraces more or less following the contours of the ground.

The leveling of the sites for the catalytic cracker, vacuum unit, and lubricating-oil plants has involved the removal of approximately 200,000 cu. yards of material, much of it rock. Fortunately, the rock is fissured and blasting has not had to be extensively used. Good use has been made of the spoil in forming flat sites for tankage, railway sidings, stores, and miscellaneous plants which do not necessitate the use of high bearing pressures on foundations.

Since much of the development is taking place within the operating refinery, careful planning of the construction has been necessary in order not to interrupt production, and insure the safe operation of the existing plants. In the early phases of the project, 3 years ago, due consideration had to be given to two predominating factors—(1) the urgent need for an early increase in crude oil distillation capacity, and (2) the serious shortage of labor and materials at that time, particularly of steel, which was in critically short supply.

The interim stage of the expansion, which is now completed, provided essentially for the installation of a 45,000-bbl. per day crude-oil unit and stabilizer plant, with a minimum of treatment plants and offsite facilities. This unit was commissioned in the autumn of 1949, several months ahead of the original target date and was the first major refinery unit to be constructed in the United Kingdom since the war. The time from getting occupation of the site, demolishing obsolete plant, and commissioning the new unit was 17 months.

Second Phase of Project

The second phase of the project is now well under way and a brief description of the major additions to plants and services follows.

The tanker terminal at the Queen's Dock, Swansea, was originally designed to take five tankers at a time, the original jetties being designed for tankers of about 10,000-ton capacity. The five original timber jetties were being severely damaged by an attack of the Teredo mollusc, and it was decided to replace the five timber jetties by reinforced-concrete jetties of modern design, capable of berthing tankers of the 28,000-ton class.

Each jetty has two main shore legs which give access to the jetty head and a central pipe bridge to carry the pipe lines. The piles used consist of spun concrete tubes up to 45 ft. long, the core being filled with a special bitumen mix. The decking is made of concrete slabs with prestressd reinforcement. Three of these jetties are already complete, and two more are under construction.

To cope with the increase of throughput additional pipe lines are being laid between the jetties and the transit site. New pumps of 625-750-tons per hour capacity, working against a head of about 600 psi., are being installed together with additional pipe lines to transfer the crude to the main tank farm, and finished products from refinery to docks.

Six 10,000-ton-capacity steam-coiled tanks have been installed at the transit site to deal with heavy fuel oil and tank-truck and tank-car facilities capable of handling 2,500 tons per 24 hours have been provided. To provide the steam for tank and line heating on this site, three water-tube boilers with a total steaming capacity of 85,000 lb. per hour have been installed.

The total storage capacity at the main tank farm will be increased to approximately 700,000 tons by the addition of a large number of all-welded steel tanks 144 ft. in diameter by 46 ft. high with floating roofs. In addition, the main pump houses have been modernized.

Increased Refinery Capacity

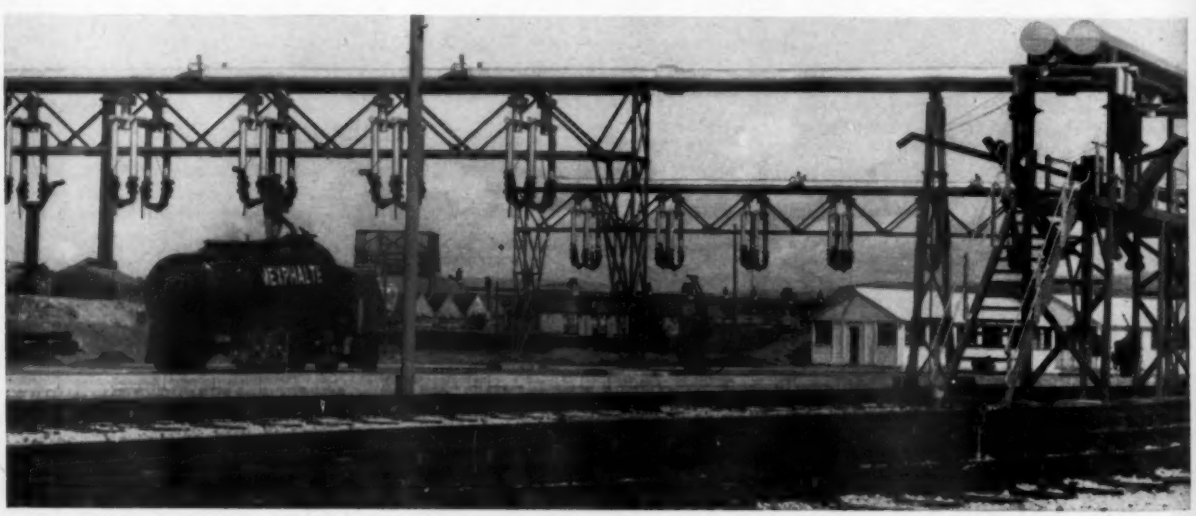
In order to provide feed stocks for the lubricating-oil plant and the catalytic cracker, the vacuum distillation capacity of the refinery will be increased by the installation of a 17,000-bbl. vacuum unit. The lubricating-oil plant includes a 3,500-bbl. per day propane deasphalting unit, a 1,250-bbl. per day furfural solvent-extraction unit, a 1,700-bbl. per day M.E.K. dewaxing and wax recrystallizing plant, a 650-bbl. per day contact clay plant, and a 350-bbl. per day wax treatment and slabbing plant.

Concurrently with the installation of these major units, plans are well in hand, and in some cases construction has already begun, on the installation of treatment plants, such as an SO_2 extraction plant for kerosine, a solutizer plant for benzene, and a number of acid washeries and rerun units. These plants will be sited in the older part of the refinery.

Most of the specialist plants are of American design, but the majority of the equipment will be manufactured in Britain and will be erected by British contractors and labor, with the help of a small team of American engineers.

The main pipe routes are being completely reconstructed, and already about 60 miles of pipe line have been diverted. The main pipe routes are 60 ft. wide and are arranged either at ground level or overhead to suit site conditions.

The process tankage is being augmented to cater for the increased



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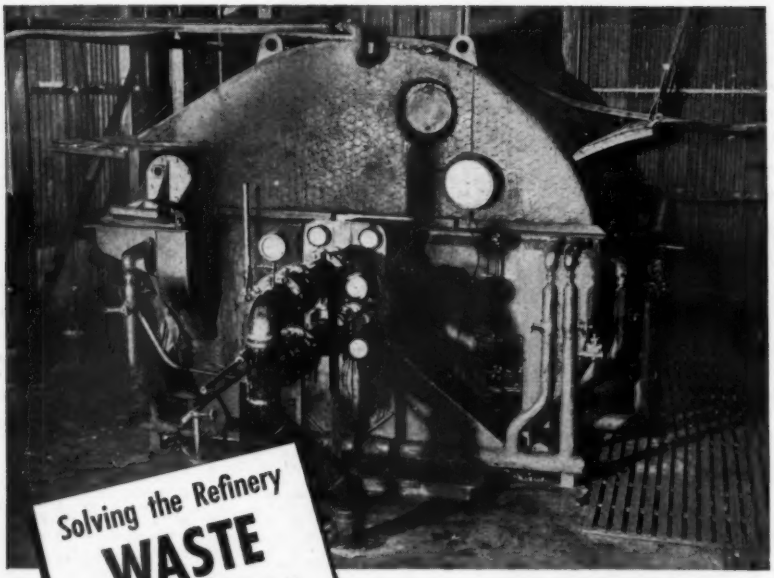

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Another very profitable use of the Oliver Precoat Filter in refineries is in connection with contact clay handling. Many are in service providing continuous handling, great reduction in oil losses over other methods, and more easily handled cake.

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number of plants and throughput. New tankage will be of all-welded construction.

Refinery Utilities

Several miles of new roads and railways are in hand to facilitate servicing the plants, and an effluent drain of 36-in. diameter has been constructed from the refinery to the outfall in the River Neath three-quarters of a mile distant. Oil and water separators of modern design are also being installed.

The process-steam requirement of the expanded refinery is estimated at about 600,000 lb. per hour, and the total electrical load about 21,000 kw. In order to achieve maximum thermal economy, power will be generated on back-pressure turbo alternators. The turbines will take steam at about 550 psi. To provide this steam four 150,000-lb. per hour water-tube boilers operating at a pressure of 600 psi. are being installed.

A new power station with a normal generating capacity of 12,000-15,000 kw. is under construction. The kw. generated will be matched to process steam demands. The remainder of the electrical load will be taken from the British Electricity Authority grid at 33,000 volts, and the power station and grid supplies will be distributed at 11,000 volts from a central control building to about 15 area substations of 2,500 kva. capacity each.

At each substation there will be a stepdown to 3,300 volts for motor supplies above 50-hp. rating, 440 volts for motors below 50 hp., and 250 volts for lighting, heating, and instrument supplies. In certain areas where the loads are scattered and where secondary distribution at 3,300 volts is more economical than at 440 volts, satellite substations will be provided.

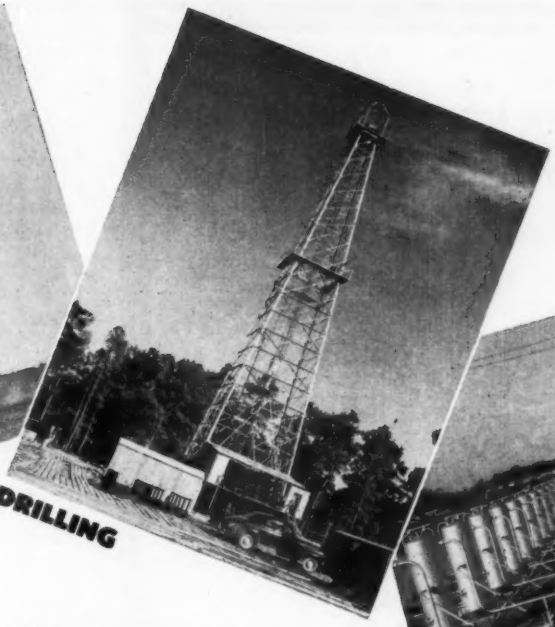
In order to insure continuity of supply the feeders to each substation will be in duplicate. The more important substations will be provided with a third feeder which automatically switches on in case of failure to either of the other two feeders and at the same time allows full maintenance to be carried out at any time. All electrical equipment will be of certified flameproof construction.

Steam will be distributed at about 175 and 25 psig. Steam from turbine exhausts at 175 psig. and 100° F. superheat to allow for line losses will be used on the various process units for heating and driving pumps, air and gas compressors, at a controlled pressure of 150 psig.

The prime movers will exhaust into the 25-psig. steam mains which supply steam for purposes where a high temperature is not required. Condensate will, as far as possible, be returned for use as boiler feed. On new plants 80 per cent condensate recovery is planned.

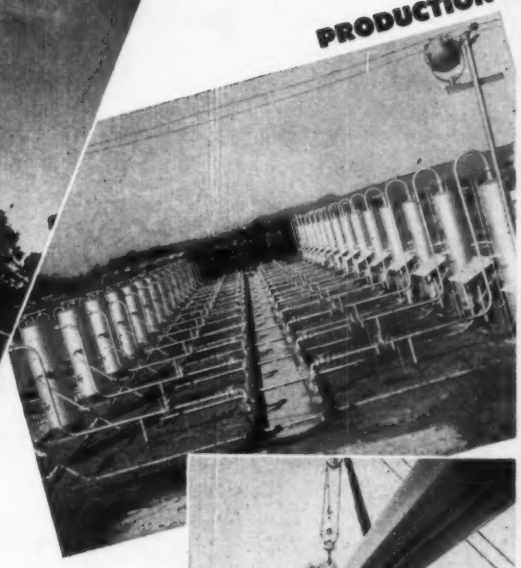
The total cooling water which will

EXPLORATION



DRILLING

PRODUCTION



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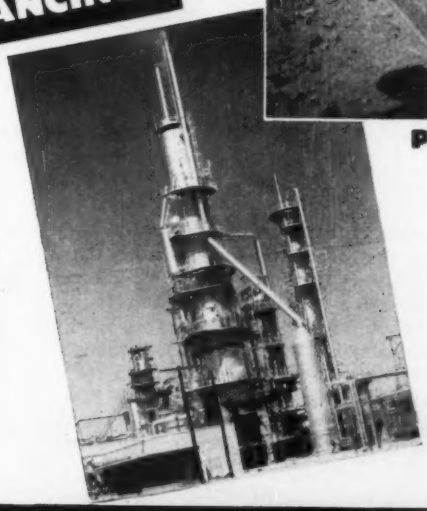

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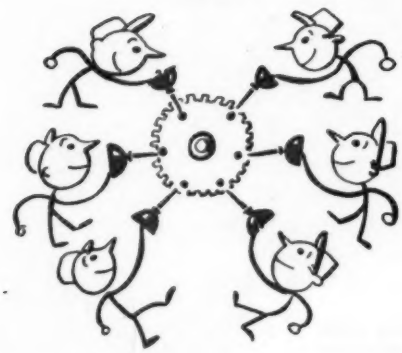

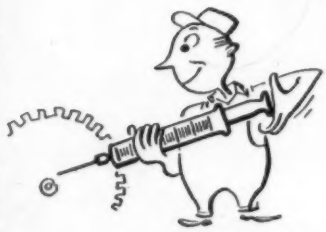

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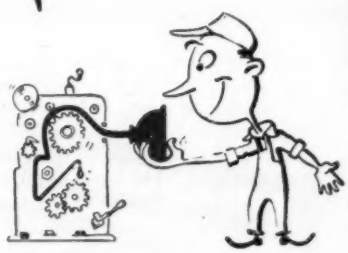

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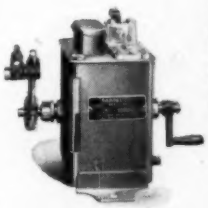

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be circulated per day is estimated at about 100 million gallons and as existing cooling reservoir of 93 million gallons capacity will be augmented by three concrete cooling towers, each capable of cooling 15,000 gpm. from 120° to 80° F. The first of these towers, 162 ft. in diameter by 230 ft. high, is in operation.

The circulating pumps will be electrically driven with diesel standby in certain cases, the diesel sets coming into operation automatically in the event of power failure.

After passing through the plants and before being recirculated through the cooling tower, the warm water passes through separators for removal of entrained oil.

The installation of the cooling-tower system has necessitated considerable alterations to the reticulation of the old reservoir cooling system. For cooling-water makeup and chemical solutions, about 4,000,000 gal. per day of water will be pumped from the Tennant Canal which is about ½ mile from the refinery. About 1,000,000 gal. per day of water from the public supplies will be needed for domestic purposes, laboratories, and boiler feed makeup.

Other Services Improved

Process units and boiler house will be fired by bituminous fuel and/or refinery gas, the total fuel consumption being equivalent to 800 tons of oil a day. A central works fuel pumping station is being developed where the oil will be heated, filtered, and distributed through steam-heated mains at about 200 psig. to the various units. Many other services such as engineering workshops, fire fighting, compressed air, laboratories, and stores are being greatly augmented and improved.

Amenities are not being neglected and plans for permanent canteens for the 2,500 people who will be employed on refinery operations and maintenance are well advanced. In addition to these canteens, hot meals will be distributed by mobile canteens to operators unable to leave their plants. The main units are provided with messrooms where the operators can have their meals while on duty. A large extension to the existing bath house is also contemplated and the existing sports facilities will be suitably augmented.

The project construction will provide employment for about 3,000 people on site for 3 or more years, in addition to the large number of indirectly employed on the construction of the equipment is factories all over the country, as well as providing permanent employment for about 2,500 people.

The port of Swansea will also benefit from the increased tonnage handled, and the steel-manufacturing industry in the area will be assured of ample supplies of suitable-quality fuel oil.

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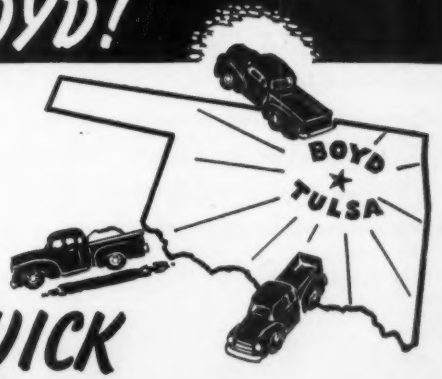

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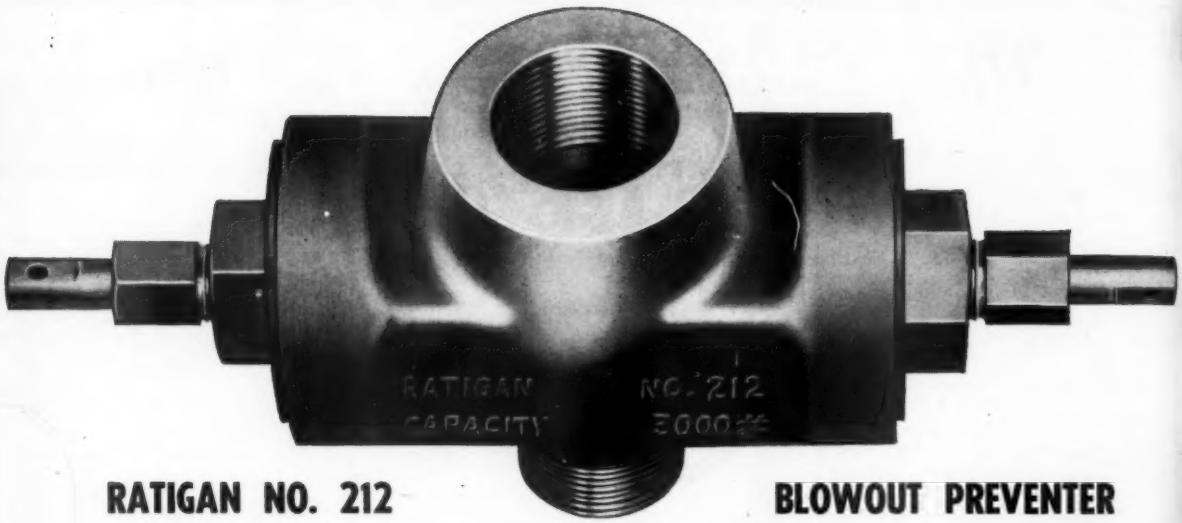

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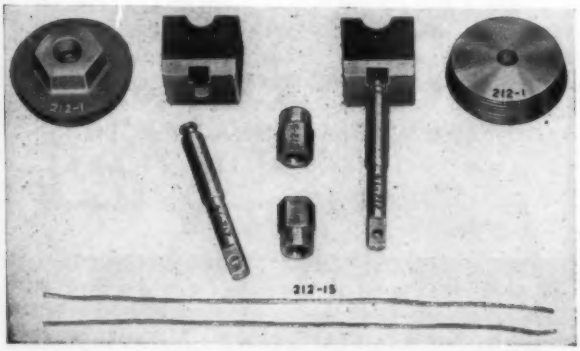

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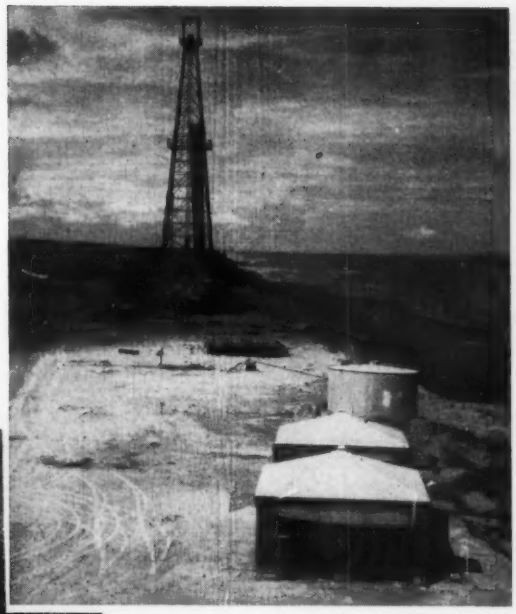


Above: Mexican American Independent Co. 3 Tortuguero. State of Veracruz, Mexico.

Left: Canal and roadway leading to Xicalango location. Widened portions of roadway are leveled "cuyos" or Indian mounds.

by Bart W. Gillespie and J. Ralph Coleman

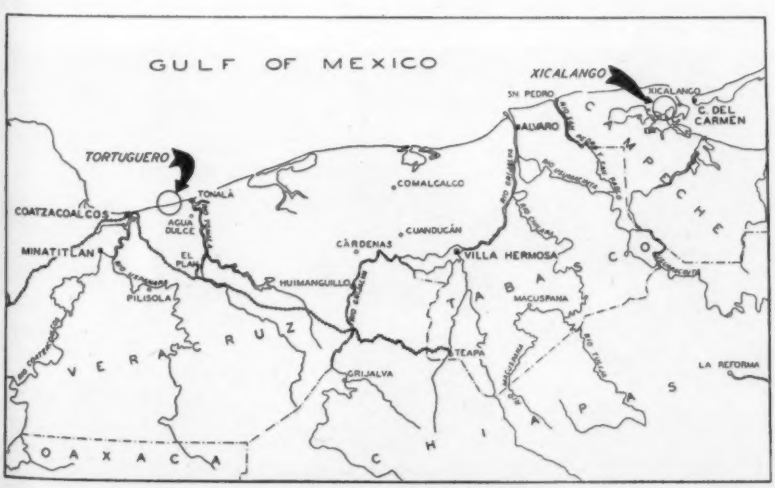
DECEMBER 1950 marks the eighteenth month of Mexican operations by Mexican American Independent Co., better known as "CIMA," the organization representing American Independent Co. 53⅓ per cent, Signal Oil & Gas Co. 33⅓ per cent, and Edwin W. Pauley 13⅓ per cent, and operating under contract with Petroleos Mexicanos.

Drilling Tortuguero Structure

After setting up an organization in June 1949, CIMA contracted for, and shipped to Mexico, two drilling rigs of Kerr-McGee Industries, Inc., Oklahoma City, and 3 months later started actual drilling operations on the Tortuguero structure in southern Veracruz, 27 km. east of Puerto Mexico (Coatzacoalcos) on the coast of the Gulf of Mexico.

Prior to this move, offshore seismograph work had been under way, and was carried on continuously from late May until the middle of October of the same year. The Tortuguero structure was chosen for the initial test after examining the geophysical and geological information on a number of structures, several of which, although attractive structures, were relatively inaccessible.

The 1 Tortuguero. — This location was made on a salt dome worked out by seismic methods. It was the first offshore directional well ever drilled in the Republic of Mexico. The well was spudded during October, and was drilled at an average angle of 40° and maximum of 50°. After encountering several interesting shallow shows, the well was completed in a sand section with perforations between 1,858 and 1,907 m. (6,096 and 6,257 ft.) for approximately 300 bbl. daily. The well declined rapidly and indicated a possible thinning of the section over the top of the salt dome, local faulting, lensing, or some com-



Map of the region lying just west of Yucatan Peninsula, showing locations of Tortuguero and Xicalango operations.

binations of the three. After several weeks' testing, this well was deepened to the salt without favorable results and then recompleted with oil-emulsion mud, but proved to be no better than a 150-bbl. pumper.

The 2 Tortuguero.—This well was drilled from the shore with a deflection angle of approximately 50°, to the shallow zone below the main gas sand, and resulted in a well good for approximately 250 bbl. daily. The gas-oil ratio during the first weeks of production was satisfactory, but thereafter rose to 20,000 cu. ft. per barrel. The well was then closed in, and remedial work is now under way to correct this condition.

The 3 Tortuguero.—Still a rank wildcat this well was drilled vertically with only a normal drift seaward (6°) in an attempt to study the south flank of the structure for possible thickening of the deep producing zone. Results revealed a thinning of the deep sand, and the well was considered noncommercial. No water was encountered. This hole is now being whipstocked in a northwesterly direction to examine the west flank of the structure.

Xicalango Area

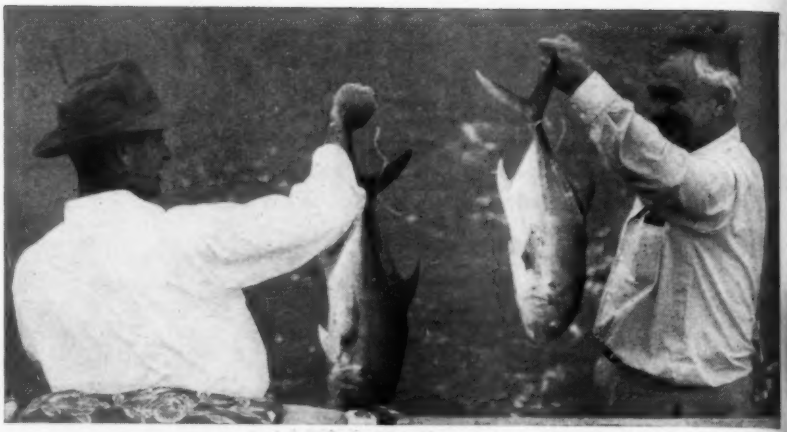
Approximately 180 air miles east of the Tortuguero activities, another well was started in what is known as the Xicalango area. Xicalango lies about 15 miles southwest of, and on the mainland from the Island of Carmen.

The 1 Xicalango.—The drilling camp and this well lie in a dense, marshy jungle at the end of a dredged canal and a short road which required several months for preparation. The well was drilled to 2,577 m. (8,454 ft.) with a National 50 rig under very difficult conditions which included abnormally high gas pressure from 900 m. (2,952 ft.) to bottom.

A near blowout was experienced at 1,100 m. (3,608 ft.) after which the mud weight was gradually increased from 12 to 17.2 lb. per gal. at the completion depth. Several interesting gas shows were encountered down to 2,150 m. (7,052 ft.) where 7-in. casing was set and cemented. The hole was then drilled to 2,577 m. (8,454 ft.) but gamma, neutron, and electric logs of this well revealed nothing of interest below 2,150 m. (7,052 ft.). Testing was confined to the interesting sands back of the 7-in., and all of the shows were found to be noncommercial except the zone, lying from 1,367 m. (4,484 ft.) to 1,396 m. (4,579 ft.) which proved to be a gas well. This well actually flowed 30,000,000 cu. ft. per day through 2½-in. tubing, and has been conservatively calculated as having an open flow capacity of 83,000,000 cu. ft. daily.

The 2 Xicalango.—This well was drilled 937 m. (3,073 ft.) southeast of No. 1 down dip to locate, if present, an oil ring on the flanks of the structure. Unfortunately, the flank drilled was deeper than indicated by seismic records, and the sand was topped 161 m. (528 ft.) lower than in No. 1 and found to be wet. This well was whipstocked updip at an angle of approximately 30° to locate the water oil or water-gas contact. The sand was topped 14 m. (45 ft.) lower than in No. 1, and the well is being completed as a gas well.

The gas produced in Xicalango has no ready market since the well is located some 400 miles from an exist-



Coauthors J. Ralph Coleman, left, and Bart W. Gillespie, right.

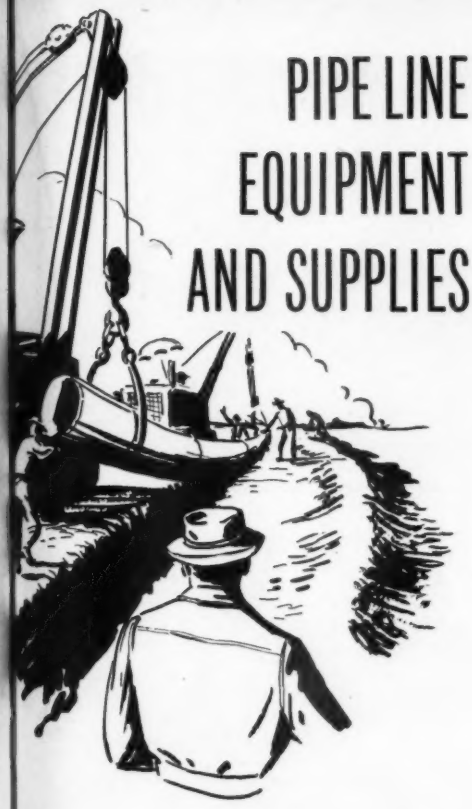
THE AUTHORS

General manager of the CIMA organization is Bart W. Gillespie, well known to the oil industry in both domestic and foreign operations. Gillespie was active for a number of years in the drilling, exploration, and equipment branches of the oil industry in California, and spent several years in Mexico and South America prior to World War II. During the war, Gillespie was a captain in the Seabees, and was a special assistant to Adm. Ben Moreell in charge of the Navy's 100-octane-gasoline program. He also directed the drilling and exploration program which the Seabees conducted in Naval Petroleum Reserve No. 4, northern Alaska. After the war, and prior to coming to Mexico, Gillespie headed Arctic Contractors, formed by a group of American oil and construction men to carry on the Navy's exploration program in Alaska.

Assistant general manager of CIMA is J. Ralph Coleman, who assisted Gillespie in the Alaskan exploration job, serving in the dual capacity of chief engineer and drilling superintendent. Coleman was engineering officer on a destroyer escort in the Navy during the war, and prior to the war was for several years an engineer for the Gypsy production division of Gulf Oil Corp. He has taught petroleum engineering at University of Texas, and at the Missouri School of Mining and Metallurgy.

Xicalango camp is located a little more than 18.5° north of the equator.

PIPE LINE EQUIPMENT AND SUPPLIES



Every piece of CROSE equipment is backed by a complete stock of replacement parts to keep you in operation without delay. CROSE service, backed by personal attention, is second to none in the pipe line industry.

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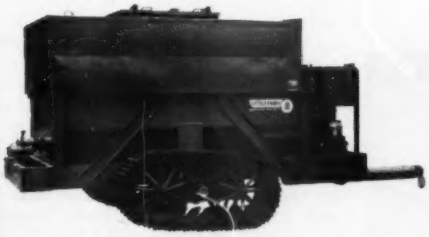
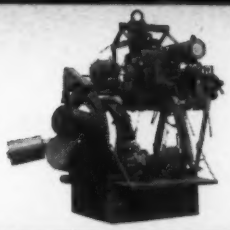
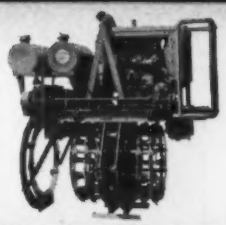


CROSE-LITTLEFORD 30-BARREL PIPE COATING KETTLE

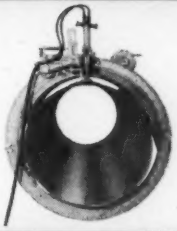
These kettles are also available in both 23-barrel and 10-barrel capacities.



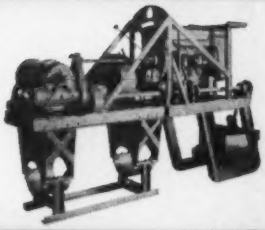
CROSE 22" - 26" Line-Traveling COATING and WRAPPING MACHINE



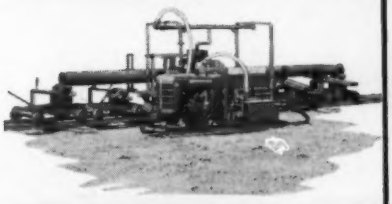
CROSE Model "K" PIPE CLEANING and PRIMING MACHINE



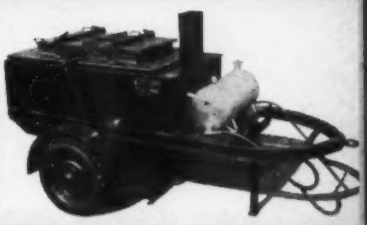
CROSE PIPE CUTTING and BEVELING MACHINE



CROSE Auger-Type ROAD BORING MACHINE



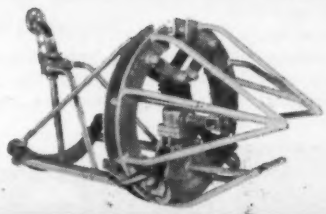
CROSE STATIONARY COATING and WRAPPING MACHINE



CROSE-LITTLEFORD 225-Gallon PATCH KETTLE

CROSE PIPE CRADLE

CROSE ENDLESS PIPE BELT SLING



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CROSE PIPE WRAPPING MATERIALS
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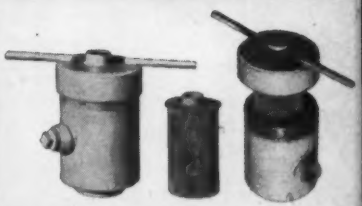

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A view of labor camp, I Xicalango, the easternmost operation of Mexican American Independent Co.

ing pipe line and almost 350 miles from a city capable of consuming the quantities of gas which the structure can produce. With carbon black increasing in demand and ammonium nitrates always required, it is probable that this gas reserve will be utilized within the near future.

Nature of Contract With Pemex

The contract signed in March 1949 by Petroleos Mexicanos and the three coventures was the first of a number of similar contracts in which foreign capital took the initial risk of exploring for oil in Mexico under contract with Petroleos Mexicanos, and depends directly on the discovery of hydrocarbons for a return of its investment and profits.

The contract covers a period of 12 years of actual operations, and 25 years as the period of payoff. The sovereign rights of the nation are recognized in that the investors never will take ownership of the subsoil, and are at all times answerable through Petroleos Mexicanos to the Ministry of Economy. Further, CIMA is subject to reasonable supervision and control by Petroleos Mexicanos, and, on completing wells, depends on that agency for the production of wells it has drilled.

Unloading drilling equipment on dock at Coatzacoalcos, Veracruz.

Transportation

Emergency requirements, always a problem in operations carried on in isolated regions, are met by the use of either company-owned planes, or when necessary chartered planes of greater capacity. In instances, drill pipe has been moved from Texas to Tampico or Veracruz by trucks, and thence by small coastwise steamers to Puerto Mexico. Also, procurement of a great number of spare parts, provisions, etc., is made in Mexico City, and this material is moved to the field by company-owned or commercial aircraft.

In addition to the air support mentioned above, CIMA has under charter an LCT, which because of its low draft and drop-bow door, is capable of navigating the shallow lagoons in the Xicalango area, and can load and unload cargo without requiring docks. All movement of heavy cargo, except in the immediate vicinity of the well site, must be made by water.

The nearest landing field to support Xicalango is located at Carmen, which is approximately 15 miles via water from the gas field. An LCVP owned and operated by CIMA closes this gap in the supply line. CIMA also owns an LCM equipped with tanks fitted for hauling fresh water which must be brought in from a distance of approximately 35 km.

The drilling crews of Mexican American Independent are made up largely of Mexican nationals.

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SERVING COST-MINDED MANAGEMENT FROM COAST TO COAST

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The large photo shows a Universal type Container being transported at the Celanese "Celriver" plant, while two small photos show how a special 10 cu. yd. container is lowered and placed in loading position under bin. Dempster-Dumpster then moves on to service another container. Both type containers have drop bottom dumping action, and are emptied automatically from hydraulic controls in truck cab.

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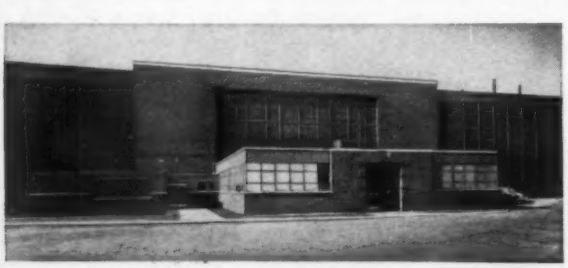

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Field camps.—Two camps support the major operations. Texas-type screened tropical huts form the bulk of the structures used. Prefabricated steel warehouses adequately house spare parts, cement, drilling mud, and miscellaneous articles in storage. Other housing for some of the local workmen was constructed from native material available at the location.

Both areas being explored lie in a fisherman's paradise where tarpon, bass, barracuda, yellow tail, and sailfish are found in abundance. The regions are subject to severe rain and thunderstorms, and occasional high wind although this country lies only on the fringes of the tornado paths.

Exploration

Water geophysical work using American Exploration Co.'s crews was carried out under unusual circumstances with duplicate equipment provided to speed up operations. The net result was a low per profile cost which actually was less than similar seismic operations carried on off the shores of Louisiana and Southeast Texas.

Exploration work carried on to date has been supported by a number of well-known American contracting specialists in addition to the contract drilling firm of Kerr-McGee. Directional drilling is directed by Eastman Well Survey Co., electric logging is done by Schlumberger, mud logging by Rotary Engineering Co., cementing and formation testing by Halliburton, gas control by Otis, mud control by Baroid, and certain fishing problems have been solved by McCullough.

The isolated locations being explored make it necessary to support these operations with electric logging, cementing, and mud-analyzing units at each rig site to prevent the building up of idle rig time. Personnel to operate the mud analyzing units are necessary at each location, but it is possible to transport the other personnel by air between the two locations and thus avoid duplication of these operators and engineers.

Summary of operations.—The close of the year 1950 will show a total of five surface locations drilled, and three of these redrilled to a second objective for a total of eight tests, since the three redrilled wells were directional and were deviated from very near the surface. All but two of the wells drilled have been directional ranging from 30° to as high as 60° deviation from the vertical.

The wells completed on the Tortuguero structure all have been capable of producing oil in quantities varying from 100 to 300 bbl. daily. Two noncommercial tests were drilled, but both of these were plugged back and redrilled to a more favorable location on the structure. The gravity of the deep-sand production is approximately 35° A.P.I. while that from the upper sands is approximately 23° A.P.I.

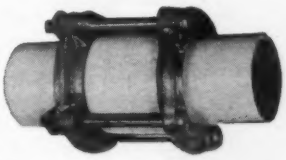
The first and third wells drilled at Xicalango were large gas wells and produce gas which is 99.7 per cent methane. The second well drilled on the southeast flank encountered salt water.

The future exploratory program of the Tortuguero structure will no doubt follow the pattern usually followed in exploring salt domes in most successful searches for oil in other parts of the world. At present, the west flank is being examined. The east and north flanks must still be examined before the structure is completely tested.

The Xicalango structure may remain idle for a short period of time pending the completion of plans to utilize the gas reserve already indicated.

Still to be examined by CIMA are other offshore structures worked out by geophysical surveys and at least two major structures lying inland in the State of Tabasco.

That the relationship between the two contracting parties has been so agreeable during the life of the contract is due to a great extent to the



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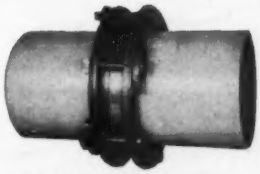

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Style 79B, for repairing pitholes and longitudinal splits in pipe.

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character of personnel who compose Petroleos Mexicanos.

Pemex personnel.—Antonio J. Bermudez, director general of Petroleos Mexicanos, is closely surrounded by men who have dedicated their professional careers to the advancement of the industry. Ing. Jose Colomo, technical subdirector; Ing. Manuel Rodriguez Aguilar, manager of exploration; and Ing. Alfonso Barnetche, manager of exploitation, form a strong body of advisers under whom are a great number of well-trained engineers and technicians. It is with this group of men that CIMA works very closely, and, it is because of the type of personnel composing the directing body of Petroleos Mexicanos that CIMA has been able to function with complete harmony.

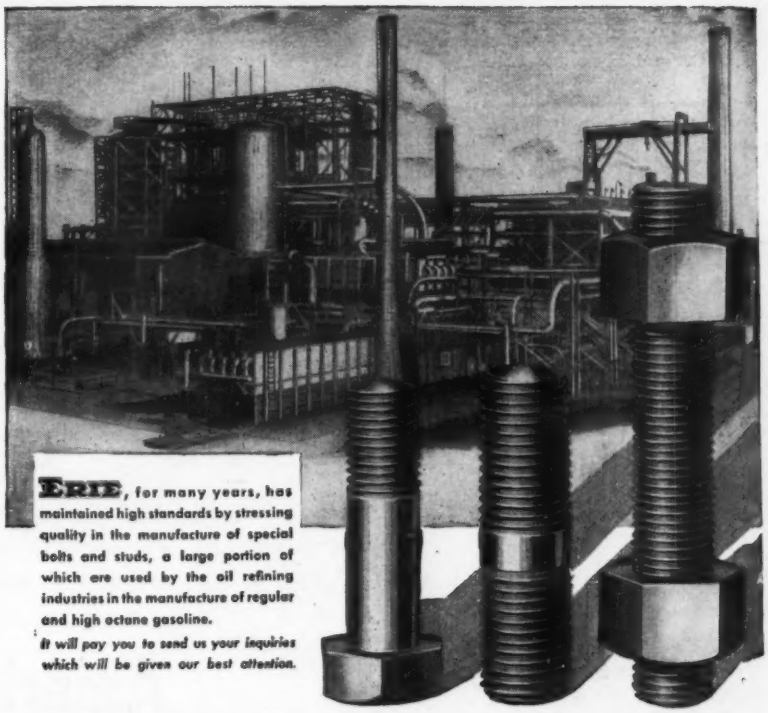
Mexican Technical Personnel

CIMA has set up an organization of engineers and technicians possessed of sound petroleum experience and a good background of foreign-operations experience. The directing heads include men experienced in petroleum exploration and development in Mexico, Venezuela, Peru, Argentina, Alaska, the Near East, China, as well as in the United States. The CIMA organization is composed largely of Mexican citizens. Only the key supervisory and technical personnel have been drawn from the United States oil industry.

CIMA personnel.—Puerto Mexico is the field-operations center of CIMA's work in Mexico. Offices have been set up in that city, and all work is directed by Mike H. Bush as general drilling superintendent. Bush is a veteran of foreign drilling work who has worked in the Near East, Far East, Argentina, and Venezuela.

CIMA's chief geologist is E. Stewart Barclay, who was formerly for several years with Phillips Petroleum Co. in Venezuela as chief geophysicist, and more recently was connected with the geological department of that company in the United States. Chief petroleum engineer is Charles L. Moore, who has had many years of experience in the oil industry and is well known on the West Coast.

The procurement organization, a very important phase of all foreign operations, was set up by John R. Dallerup, formerly vice president of Reed Roller Bit Co. and ex-commander of Navy Seabees. The procurement branch, located in Houston, is now headed by Donald H. Meek, a Texan with much experience not only in procurement, but also in foreign and Gulf Coast drilling. He is responsible for purchasing, clearing for export, and shipping of all materials to Mexico. Shipping is a problem requiring exact timing since there are few ships calling at Puerto Mexico equipped to handle the heavy lifts so often a part of oil-well drilling cargo.



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(Above) Putting on *Air-Paks.*
(Below) Tying in 2" gas main carrying 15 lbs. pressure.

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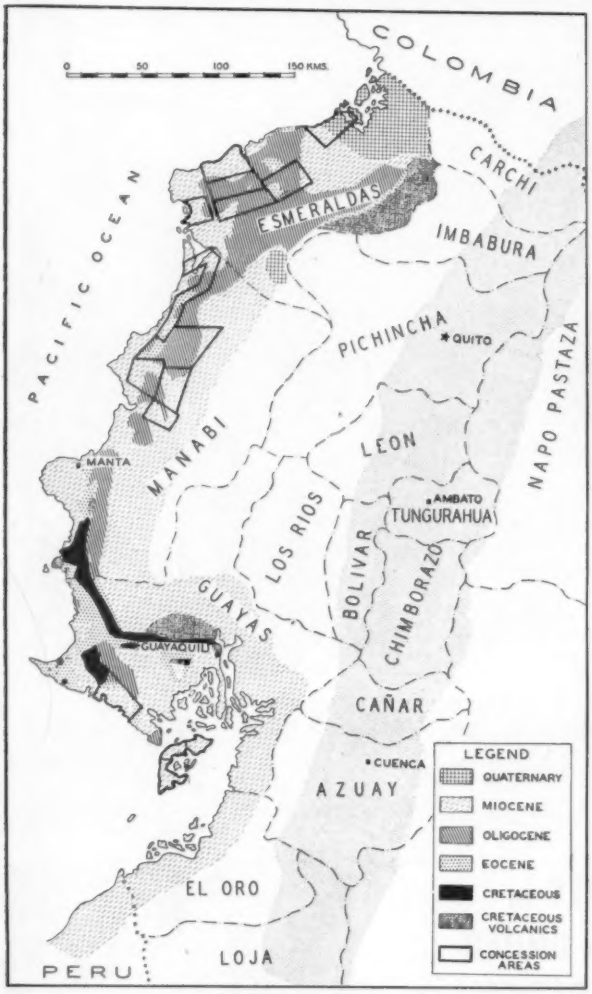
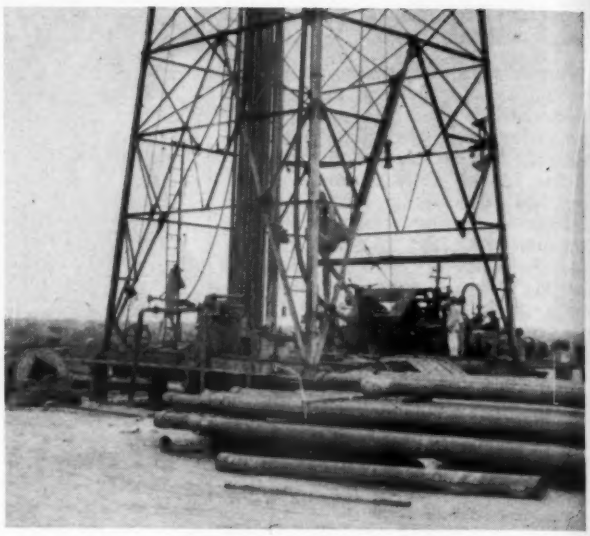


Fig. 1—Map of western Ecuador.



One diesel and three steam rotary rigs are operated in Ecuador by Ecuador Oilfields, Ltd.

American Concern Planning an Active Drilling Campaign In Ecuador

by Cecil V. Hagen

TODAY, with the real threat of war seemingly apparent for some years to come, the geographical location of oil fields and of favorable areas for oil exploration are of prime and increasing importance. Great as is the total production of oil in the world, a substantial portion of it is extremely vulnerable to capture by an invading aggressor.

As concerns the United States, the availability of an oil supply situated in the Western Hemisphere and particularly along the west coast of South America becomes strategically desirable. Oil tankers could haul their liquid cargoes directly to our West Coast ports, obviating passage through the Panama Canal.

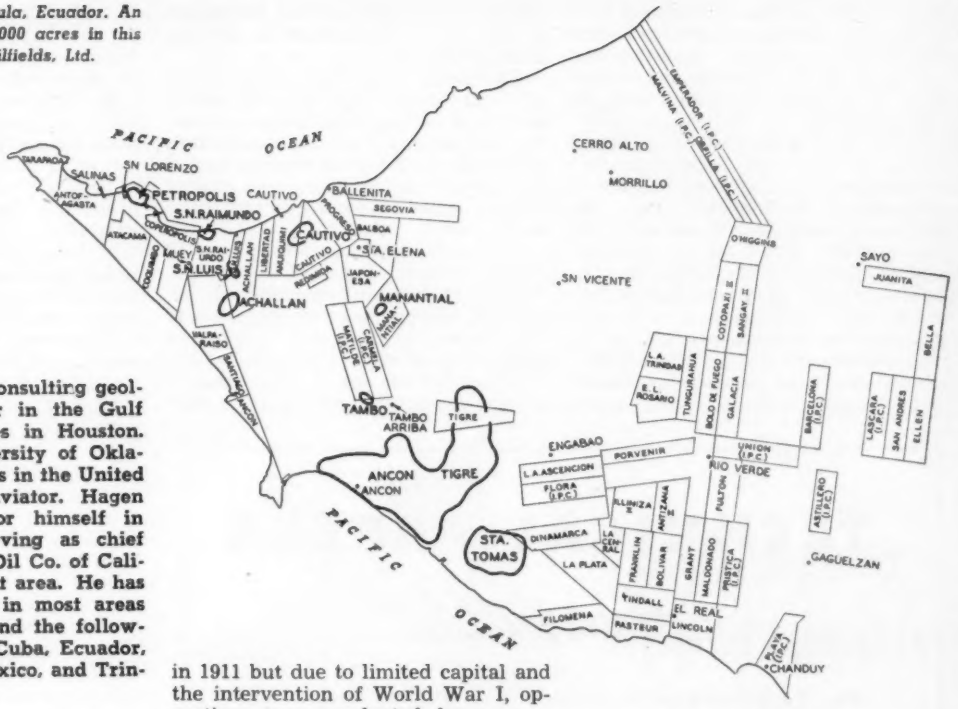
At present the only oil production along the western South American coast is that from Peru and Ecuador, with the entire production from the latter country being concentrated on the Santa Elena Peninsula in southwestern Ecuador. The nearest production on the Pacific Coast north of Ecuador is in the Los Angeles basin, California. This country, with its strategic geographical location, its liberal mining and petroleum laws, and its potential possibilities for successful wildcatting and increased oil production seems to hold bright promise for the future.

With the above-mentioned and other considerations in mind, Manabi Exploration Co., Inc., was formed in January 1949, by a group of independent Texas, Louisiana, Oklahoma, and New York oil men, to obtain and explore oil concessions in Ecuador. The company acquired an original grant of some 984,000 acres situated in the large Jipijapa-Quininde sedimentary basin near the central coastal area in the Province of Manabi. To this was added, shortly afterward, about 1,197,000 acres in the form of 12 concession areas also geologically favorably located in the above-mentioned basin; in the Borbon basin, Province of Esmeraldas; in the Progreso basin, Province of Guayas; and on Isla Puna, Province of Guayas. The composite thickness of Tertiary sediments in these three basins is estimated at 50,000 ft.

Early in 1949 Manabi commenced exploratory work on some of their concessions, employing a surface geological party, one gravity-meter crew, and two soil-analysis crews. From the results of this work approximately 737,000 acres were dropped, on a basis of selectivity, from the original concession of 984,000 acres, and an additional 120,000 acres added contiguous to two concession areas in the Province of Guayas in close proximity to the present oil fields. (See Fig. 1.)

Manabi Exploration Co., Inc., at present the only American oil company in Ecuador, now holds concessions comprising 1,563,696 acres, and is planning an active drilling campaign. In the beginning, wildcat tests are to be drilled on favorable pros-

Fig. 2—Santa Elena Peninsula, Ecuador. An aggregate of more than 57,000 acres in this area is held by Ecuador Oilfields, Ltd.



Cecil V. Hagen is a consulting geologist and oil producer in the Gulf Coast area with offices in Houston. He attended the University of Oklahoma and served 3 years in the United States Navy as an aviator. Hagen went into business for himself in March 1940, after serving as chief geologist for Superior Oil Co. of California in the Gulf Coast area. He has done consulting work in most areas of the United States and the following foreign countries: Cuba, Ecuador, Venezuela, Canada, Mexico, and Trinidad.

pects southeastward along the coast from Santa Elena Peninsula which were developed during the year of exploratory work.

At the time Shell Co. of Ecuador, Ltd., decided to withdraw from Ecuador and relinquish its 12-million-acre concession in the jungles of the "Oriente" east of the Andes Mountains, Manabi instituted negotiations for the purchase of certain drilling and other equipment. One complete power drilling rig capable of drilling to 7,000 ft., core barrels, fishing tools, tubular goods, drill pipe, and some automotive equipment were obtained in the transaction and delivered to Manabi at Duran just across the river from Guayaquil.

Probably the item of greatest interest in the development of Manabi Exploration Co., Inc., was the recent move to acquire certain British oil properties in Ecuador. On August 31, 1950, Manabi entered into an option agreement to purchase either all the assets of the Ecuador Oilfields, Ltd., or all the shares of stock issued and outstanding of that company which is owned by British Oilfields, Ltd. Upon the payment of certain cash considerations this option agreement can be in effect for a total of 210 days.

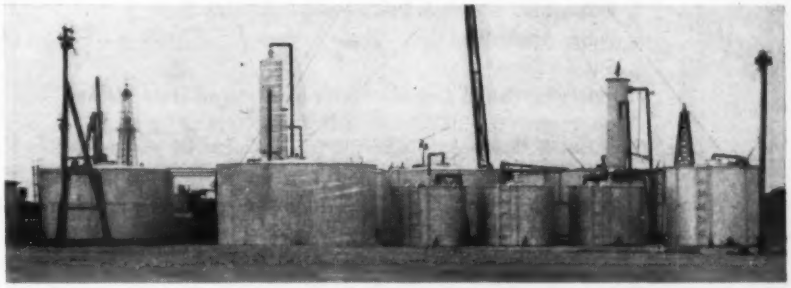
Ecuador Oilfields, Ltd., with its headquarters and main camp located at Cautivo on Santa Elena Peninsula, holds under five concessions from the Government of Ecuador, 61 blocks or parcels of land covering in the aggregate 23,176 hectares or about 57,268 acres located on or contiguous to the Santa Elena Peninsula. (See Fig. 2.)

Ecuador Oilfields, Ltd., was formed in 1911 but due to limited capital and the intervention of World War I, operations were conducted for a number of years on a restricted scale, small production being obtained from very shallow wells.

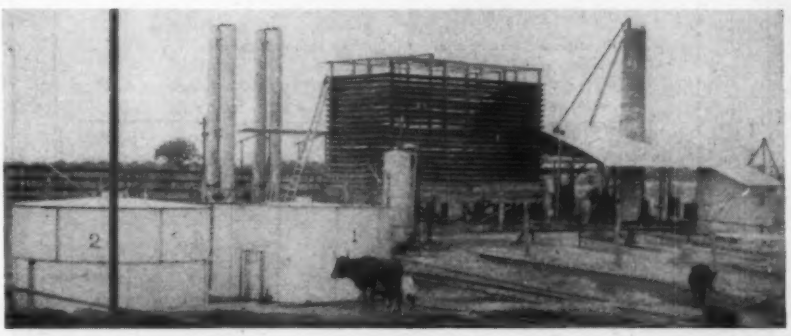
In 1933 British Oilfields, Ltd., acquired the whole of all shares of stock issued and outstanding of the company, and thereafter provided such additional finance as it could spare.

Tigre Field

Production from Tigre field (Ancon area), the present main producing source, was not established until 1938. However, development was impeded and the delivery of essential oil-field equipment was drastically reduced by the advent of World War II. Drilling operations during this time were con-



Crude-oil storage tanks on the properties of Ecuador Oilfields, Ltd. Average monthly production was 39,300 bbl. for the first half of 1950.



This small gas-absorption plant operated by Ecuador Oilfields, Ltd., is capable of extracting 500 bbl. of gasoline monthly.

ducted with only one drilling rig. Production was increased as more equipment became available after the war, but because of lack of finance large-scale exploratory drilling has not been possible.

Tigre field, which covers approximately 988 acres, has been the source of about 90 per cent of the company's production. From 1938, when the first well was brought in, until the end of 1949, the total accumulated production for Ecuador Oilfields, Ltd., from this field has been 4,130,734 bbl. of oil. For the first 6 months of 1950 the monthly average production for the company has been 39,300 bbl. The gravity of the oil is good, the Baumé being consistent at 38°. A quantity of gas equivalent to about 20,000 bbl. of oil is utilized annually as fuel for field operations.

The structure of Tigre field is that of four major faulted and tilted blocks of Lower Eocene beds covered by Middle and Upper Eocene sands and shales. The area is complicated but enough wells have been drilled to give a general picture of structural conditions.

The surface of the area is covered to an average depth of 100 ft. by "Tablazo" deposits consisting of calcareous conglomerates and gravels of Pleistocene age. Beneath this occurs some 1,200 ft. of the Seca formation of Upper Eocene age, made up mainly of thin sands in shale. This in turn is underlain by the clay pebble bed of the Socorro formation which is Middle Eocene. It attains a thickness of approximately 800 ft. of shale with included clay pebbles. Apparently an unconformity separates it from the underlying Azucar series of Lower or Paleocene age. The Atlanta sandstone, which is the producing horizon in the field, has been correlated for some time with the thick sandstone of the Azucar, which series is estimated as being 8,000 ft. thick. The Atlanta producing section is approximately 2,100 ft. in thickness and is composed of conglomerate, some very hard sandstone, and fine soft friable sand.

The top of the Atlanta has been penetrated by the drill at depths ranging from 1,800 to below 5,000 ft. Its porosity is low, estimated at 6 per cent over-all. Primary permeability is also very low, but secondary permeability caused by fracturing varies from low to very high. Deepest test to date on the peninsula was a 9,000-ft. dry hole which ended still in the Atlanta sandstone.

No evidence of a water drive has yet been determined, and it is believed the field is essentially one of a gas-solution-type drive. The average initial production of field wells is about 200 bbl. per day with some wells producing initially as high as 1,000 bbl. and some as low as 15 bbl. per day.

In addition to the production at Tigre field, other shallow wells of Ecuador Oilfields, Ltd., located in various areas on the Santa Elena Peninsula continue to yield about 2,700 bbl. monthly of heavy crude, a rate which has prevailed for a number of years.

The area to the north and northwest of Tigre is highly folded with local igneous intrusions. Oil is found adjacent to these intrusions unrestricted by stratigraphy. Production is encountered in cherts of different ages (some probably Cretaceous); igneous rocks probably Oligocene in age; fractured and silicified shales, and thin sands of the Eocene. Oil obtained from hand-dug pits on the peninsula was used by the natives before the Spaniards conquered the country. Today production is still obtained from these walls as deep as 1,500 ft.

ANNUAL PRODUCTION, ECUADOR OILFIELDS, LTD., TIGRE FIELD

Year ended	No. of wells	Bbl.
1945	17	402,266
1946	20	435,214
1947	25	513,385
1948	28	615,948
1949	32	482,940
Total	..	2,449,753
Total production from 15 wells to end of 1944	..	1,680,981
Total accum. production	..	4,130,734

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CRUDE OIL PRODUCTION IN BARRELS—ECUADOR OILFIELDS, LTD.

Year ended	Tigre field	Other areas	Total
1946	435,214	34,141	469,355
1947	513,385	36,844	550,229
1948	615,948	34,249	650,197
1949	482,940	32,097	515,037
Total	2,047,487	137,331	2,184,818

Included among the physical assets of Ecuador Oilfields, Ltd., are staff and employe houses, main office, stores, workshops, garages, automotive equipment, machinery, drilling equipment, and a small motor vessel.

The drilling equipment consists of a steam rotary rig capable of drilling to 8,000 ft., two steam rotary rigs designed to drill to 6,000 ft., one diesel rotary rig which can go to 5,000 ft., and a complete portable drilling rig adequate to depths of 1,500 ft. There are 10 oil-storage tanks on the property with a total capacity of 129,900 bbl.

A small company-owned refinery or skimming plant has a crude-charging capacity of approximately 600 bbl. a day. A gas-absorption plant capable of extracting 500 bbl. of gasoline monthly is also in operation.

In 1940 the company built a 4-in. pipe line 11 miles long extending from Tigre field to Cautivo. This line can handle 2,500 bbl. of oil daily and has one pumping station.

When Manabi takes over the operations of Ecuador Oilfields, Ltd., exploratory work on the concessions Manabi now holds will be coordinated with exploration and exploitation drilling on these newly acquired concessions. One exploratory rotary rig will be used for continuous drilling during the dry season of each year on the concessions Manabi originally held. As there are several proven locations to be drilled within Tigre field one exploitation rig will be used for this purpose, and another employed in wildcatting on the unproven concession areas now held by Ecuador Oilfields, Ltd.

Ecuador's Petroleum Law

It might be well at this time to mention something of the petroleum law of Ecuador with its various provisions governing oil exploration and exploitation in that country. This law is an outgrowth of the parent general mining law and has been in effect since August 6, 1937. An amendment to some of the articles of the law was decreed the following year.

Ing. Enrique Coloma Silva, director general of mines at the time, formulated the petroleum law after a thorough study of similar laws in various other countries.

One of its major premises is that the state has sole ownership to all natural resources in the soil, in spite of private ownership of such land, and that any concessions granted for exploration or development of these resources has to come from the federal government.

The government has the right and will grant two types of petroleum concessions, namely: concessions under contract, and concessions under denouncement. When the grant is made under contract there is allowed a study or exploration period of 5 years. The term of the exploration period is for 40 years, and is renewable for another 10 years. The maximum land grant for any one concession under contract is 50,000 hectares (123,550 acres), which may be enlarged under certain conditions, and the minimum 400 hectares (988.4 acres).

Concessions under denouncement offer an exploitation period of 20 years renewable for 5 years. The study or exploration term is for 2 years. Under this type of concession the maximum land granted is 80 hectares (197.68 acres), and a minimum of 4 hectares (9.88 acres).

Exploitation work must begin at the end of the exploration period, but can commence any time during that period.

All persons or companies, foreign or national, capable of obligations, may obtain the rights granted by this law, but in no case will these be granted to foreign governments, or corporations subordinate to them, nor

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to foreign companies which do not become legally established in Ecuador.

At the time a contract is signed security in the form of a cash bond is required to be deposited in the Bank of Ecuador payable to the government. The base fixed by law for such security is 10,000 sucres plus 1 sucre for every hectare granted in the concession (at the present rates of exchange one sucre is equal to approximately $.05 in United States currency; there are 100 Ecuadorian cents to the sucre).

The purpose of the bond is to guarantee that exploration will take place. If exploration work is not commenced during the first 2 years of the contract the bond is forfeited. After completion of the exploratory period, the bond shall be refunded. It may also be refunded at any time during this period if it is proved that a like amount has been invested in work on the concession.

The government will accept at any time the return of lands found to be unnecessary for the development of the concession, and refund the bond or security in proportion to amount of land surrendered.

Should work on, or operation of a concession grant be suspended by force majeure or other justifiable causes, the terms of the concession will be extended for a like period.

The bond in the form of cash or mortgages for the term of exploitation is fixed by mutual agreement between the state and the concessionaire, and the amount so stipulated in the contract.

The concessionaire pays to the government annually (similar to rentals), during the first 2 years of exploration and exploitation one-fifth of a sucre per hectare; two-fifths of a sucre for the third year; four-fifths of a sucre for the fourth year; and thereafter 1 sucre per hectare each year until the expiration of the contract.

The state as the sole owner of the wealth of the subsoil shares in the production of any oil obtained on any concession. This royalty is computed in accordance with the distance from the central storage point of the respective company to the nearest shipping point, as follows:

	Per cent of net prod.*
From 0 to 50 km.	11
From 50 to 100 km.	10
From 100 to 150 km.	9
From 150 to 200 km.	8
From 200 to 300 km.	7
From 300 to 600 km.	6
From 600 and over	5

*Net production is that amount produced less the amount of oil the concessionaire uses for drilling and development work.

If oil is obtained from territorial waters, 9 per cent of the net production goes to the state.

Certain liberal custom exemptions have also been established in order to aid the development and expansion of the petroleum industry in the country. During one-half the time of the exploitation period machinery, tools, money, etc., are exempted from custom duties and other taxes.

There are numerous other important clauses in the petroleum law which need not be enumerated here. However, it can be stated that this law is workable and liberal and conducive to investment of foreign private capital. It should prove mutually beneficial to Ecuador and to those companies and individuals who operate in the country under its provisions.

New Unit in Operation

A new crude-oil distillation unit is now in operation at the La Teja refinery of Administracion Nacional de Combustibles, Alcohol y Portland, Montevideo, Uruguay.

The refinery's daily capacity rating is now 25,200 bbl. Crude-oil input to the plant is divided between three units: an older atmospheric distillation plant, a converted thermal cracker, and the new atmospheric-vacuum unit. Combined capacity of the distillation units is approximately 16,000 bbl. daily.

The converted cracking unit is geared to handle slightly more than 9,000 bbl. daily of crude-oil throughput.

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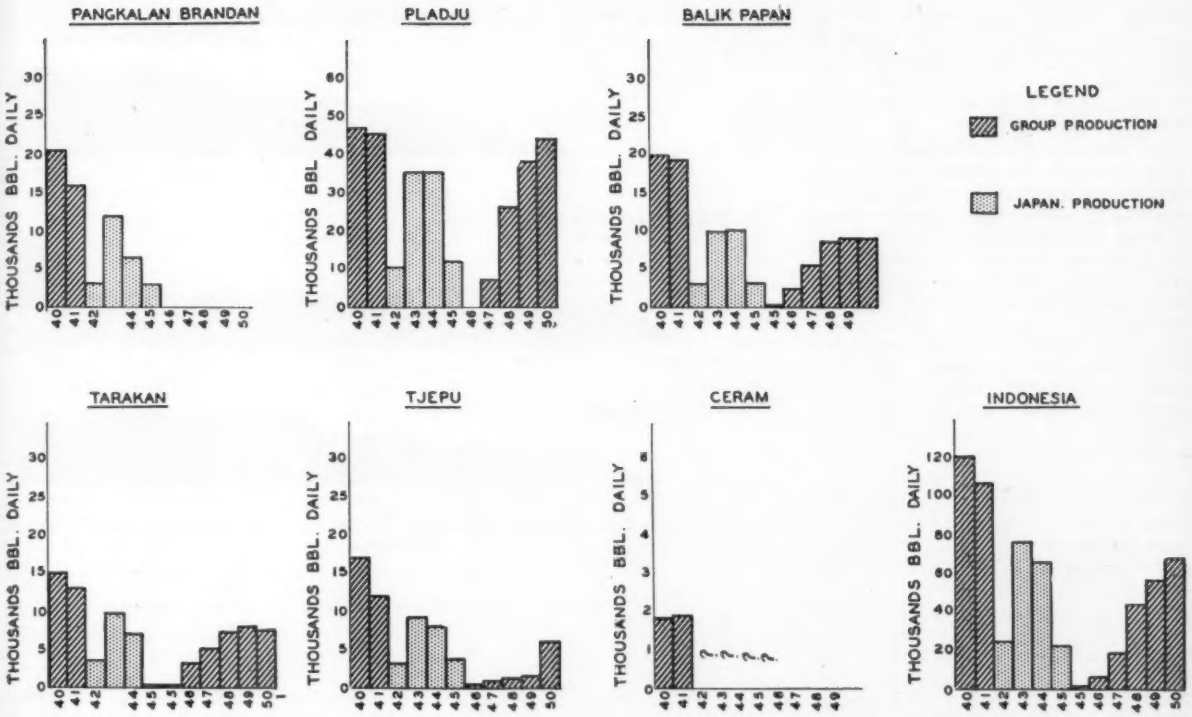


Production statistics on operations of the Royal Dutch-Shell Group in individual Indonesian oil fields and total for Indonesia. Production during Japanese occupation of the area is shown for all fields except those on the Island of Ceram where Allied bombings destroyed all surface equipment.

Indonesian Repair Work Still Under Way But Nears Its Economic Limit

Here's an account of typical oil-industry ingenuity in restoration

ON V-J Day the oil fields of Java and Sumatra were still occupied by the Japanese and in Borneo some of the fields, such as Sambodja, Louise, and Tarakan, had been reoccupied by Allied troops. As in Java and Sumatra, the fields there did not suffer the ravages of war, although much damage occurred during political disturbances; moreover, the effects of the Dutch denial action in 1941-1942 were still present everywhere.

Rehabilitation work was started immediately after Allied occupation of the Borneo fields. Owing to heavy Allied bombing and the Japanese scorched-earth policy, virtually all surface facilities were destroyed while the majority of the wells had been put out of action. The destruction of the latter—practically all pumpers—was done by raising the tubing about 180 ft. and then letting it drop. On top of the fallen tubing string a torpedo was exploded to damage the water string. The destruction was completed by filling up the well with all kinds of scrap, even hand grenades and samurai swords!

To repair these wells the drilling staff had to cope with almost insurmountable difficulties, and to their ingenuity must be credited the rather rapid rise of the production of the Borneo fields. Repair work is still going on, but is nearing its economic limit. In addition to this repair work, development drilling was also resumed, and on the island of Tarakan a deep test was drilled to 9,452 ft.

In August 1947 drilling was resumed in Tandjung field, about 190 miles southwest of Balik Papan, with a view to ascertaining the extent of the field. On the island of Bunju, northeast of Tarakan, and in Sangatta, north of Louise, where oil was known to be present, drilling was started in November 1948 and January 1949 respectively in order to investigate the possibility of future development.

In Kruka, a small field in the southern outskirts of Surabaya in the eastern part of the island of Java, preparations were made to restart production at the end of 1945. South of Surabaya exploration drilling was carried out on the Pulungan structure without success, and is still in progress in Gunung Anjar. At the beginning of 1949 the important field of Kawengan, 75 miles west of Surabaya, could be reentered. After ex-

Following the end of World War II, operating companies in Indonesia were confronted with the big problem of rehabilitating refineries, field gathering systems, and the oil wells themselves. Much of the damage to the refineries and to some of the fields was a result of allied bombing, other damage came from the hands of the evacuating Japanese Army.

This article, prepared by technical personnel of the Royal Dutch-Shell Group, for the Journal's International Number, reports on the current status of rehabilitation operations in Java, Sumatra, and Borneo.

tensive rehabilitation work, production and drilling were resumed in 1950. The oil is pumped to Surabaya and shipped to Balik Papan. The deeper possibilities of the field are being investigated.

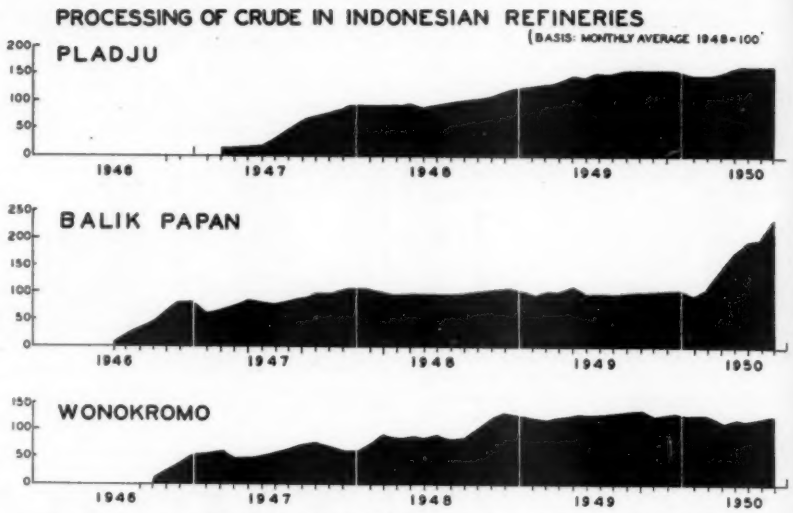
In Sumatra the important oil region of South Palembang became accessible in July 1947. Although during the political disturbances much damage was inflicted on the fields, it soon became possible to pump oil to the Pladju refinery. Development and exploration drilling was resumed and is still in progress. Talang Djimar field is in full development; the development of Tandjong Tiga, Limau, and Gunung Kemala fields is proceeding satisfactorily. To the south, the old field of Suban Djerigi is producing again.

At the beginning of 1949 the Djambi fields of Badjubang, Tempino, and Kenali Asam, and in central Palembang the small field of Mangundjaga, were reoccupied. Notwithstanding severe damage and neglect, within a short time oil was being pumped to the Pladju refinery. In Kenali Asam, two strings are repairing and one string drilling. In Badjubang and Kenali Asam the gas plants are in operation again; in the former field repressuring of the northwest part has been resumed. In Mangundjaga repair of the damaged wells is proceeding.

The oil fields of northern Sumatra are still inaccessible; in the vicinity of Medan on the east coast of northern Sumatra a deep test is drilling.

The small fields of Bula and Lemun on the island of Ceram lost all surface facilities as a result of Allied bombing.

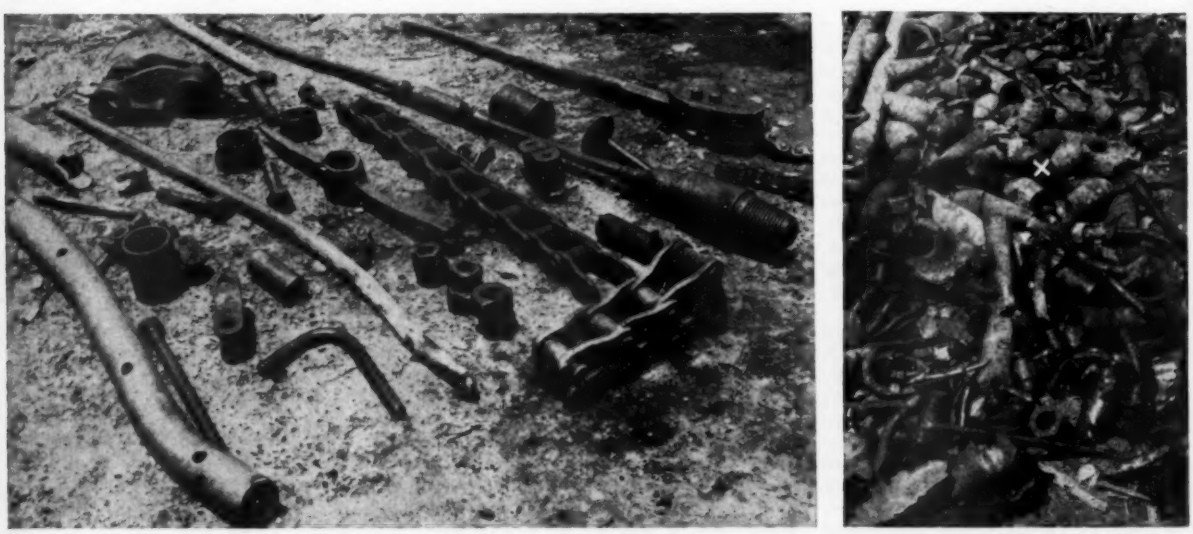
It goes without saying that rehabilitation was not limited to the wells only. Surface facilities were de-



POSTWAR DEVELOPMENT PROGRAM OF ROYAL DUTCH-SHELL GROUP IN INDONESIA

	Feet drilled					
	P. Brandan	Pladju	Tjepu Surabaya	Balik Papan	Tarakan	Total Indonesia
1946—						
Development	.....	.....	283	1,332	6,077	7,692
1947—						
Exploration	.....	.....	.....	.....	.....	.....
Development	.....	.....	677	15,416	41,547	57,640
Total	.....	.....	677	15,416	41,547	57,640
1948—						
Exploration	.....	8,683	.....	.....	9,199	17,882
Development	.....	87,110	4,359	32,961	16,203	140,633
Total	.....	95,793	4,359	32,961	25,402	158,515
1949—						
Exploration	.....	10,090	4,575	.....	11,639	26,304
Development	.....	109,007	108	34,556	24,218	167,889
Total	.....	119,097	4,683	34,556	35,857	194,193
*1950—						
Exploration	5,118	14,261	4,270	2,482	.....	26,131
Development	.....	54,506	2,536	15,370	13,568	85,980
Total	5,118	68,767	6,806	17,852	13,568	112,111

*First 6 months.



In an effort to delay returning to production various wells the Japanese filled them with miscellaneous scrap prior to their evacuation of the region. Shown here are some of the scrap items brought to the surface from one of the wells. The photograph on the right shows scrap removed from other wells. The item marked X is Japanese mortar ammunition, which was fortunately not detonated during its removal from the well.

stroyed, burned down, looted, or in a bad state of neglect. Testing units, gathering lines, pumping stations, power plants, shops, warehouses, etc., had to be restored or erected again; houses for staff and labor, hospitals, etc., had to be rebuilt; roads and bridges repaired; large parts of the fields, overgrown with secondary jungle, cleared, and the main pipe lines to the refineries and terminals examined, tested, and renovated.

At the beginning—as everywhere in Indonesia—rehabilitation was hampered by difficulties due to lack of trained staff and labor, housing, means of transport, long delivery times for necessary materials and tools, the political situation, etc. Moreover, the state of drainage of the various reservoirs became a matter of grave concern to the production staff. Under the Japanese exploitation the pressure drop, edge-water encroachment and gas-cap expansion had been very strong and extremely irregular; gradually more satisfactory conditions in the layers are being restored, but the damage done will not easily be remedied, if at all. Not only had rational development been abandoned, but the exploration for and the development of new reserves had been neglected by the Japanese, resulting in the ratio of their production to proven reserves becoming very unbalanced.

To improve this unfavorable situation geological exploration was resumed as soon as possible. In February 1947 the first geological party set out in Borneo, and in the course of 1948 surveys started in northern and southern Sumatra and in Java.

Refining

When the Allied forces landed at Balik Papan, in July 1945, they found the refinery completely destroyed by Allied bombing and Japanese denial measures; it was a mass of scrap, and the task of rebuilding seemed hopeless. However, the first distilling unit, contrived out of the materials from the old plants, started in June 1946 and was soon followed by a second unit; at the end of 1946 the total capacity amounted to about 8,000 bbl. per day.

As the production of the oil fields near Balik Papan was at that time insufficient, crude oil from British Borneo and Tarakan was imported in order to fulfill the refinery requirements. In the middle of 1947 enough crude from the fields became available. At the end of 1949 a vacuum unit and a wax plant came into operation, while in March 1950 the total refining capacity was considerably increased by a new distilling unit. At the beginning of 1951 the capacity will be 27,000 bbl. per day as compared with 48,000 bbl. per day prewar. Another large distilling unit, asphalt and lube-oil facilities, a kerosine Edeleanu plant, and an ethyl

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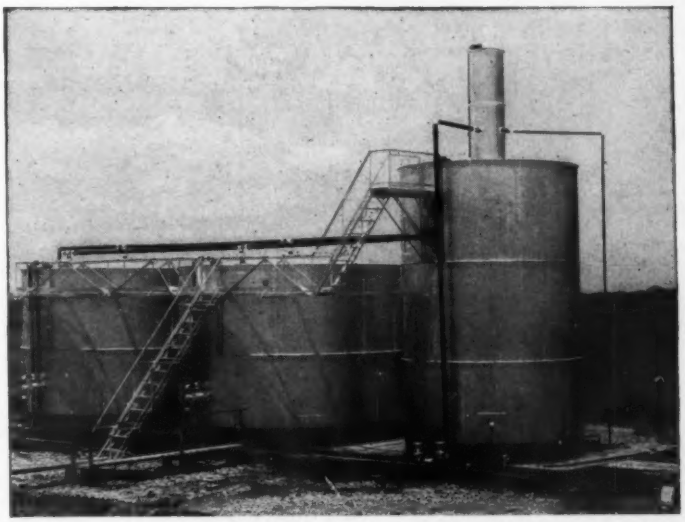

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blending plant are under construction.

The Wonokromo refinery, near Surabaya, was found to be in reasonable condition in spite of heavy Allied bombing. The distilling unit with all facilities, however, had been removed by the Japanese to Bendul, about 1 mile south of Wonokromo, where it was better hidden from the air. After thorough repair and cleaning, it came into operation in 1946 in conjunction with the asphalt plant at Wonokromo; the intake is about 2,000 bbl. per day as compared with 2,300 bbl. per day prewar. Oil from Kruka and Klamono (New Guinea) is processed there.

The Tjepu refinery became accessible at the beginning of 1949 and was found to have been seriously damaged. It is planned to rebuild the distilling unit and the TEL blending installation with the necessary auxiliaries for the manufacture of products for local consumption.

When, after capitulation of the Japanese, the Pladju refinery became accessible, it was found to be in a very bad condition due to lack of maintenance and to bombing.

In spite of many difficulties, the first distilling unit started in February 1947 followed by the kerosine Edeleanu plant; in July 1947 a second distilling unit came into operation. At the start no crude from the Pladju fields was available, but fortunately the stocks found at the refinery and a few other places in Indonesia were sufficient to keep the refinery going for a time.

In August 1947 the South Palembang fields came into production, but the output was insufficient, and therefore crude from the Middle East and British Borneo had to be imported.

In 1949 the oil from the Djambi fields also became available. When, in November 1947, a third distilling unit had been rehabilitated, the total capacity had almost reached its prewar figure. Besides the above-mentioned plants, a redistilling plant, two cracking plants, a vacuum unit, and several treating installations were also rehabilitated in the course of 1947.

In 1948 the rehabilitation proceeded steadily; the plant for the manufacture of aviation components and the gasoline Edeleanu plant were completed. A new atmospheric distilling unit designed by Alco Products was put into operation at the end of 1948, increasing the total refining capacity to some 74,000 bbl. per day as compared with 50,000 bbl. per day prewar. In 1949 the rehabilitation of the refinery was practically completed by starting up one of the reforming plants. In 1950 a new gasoline Edeleanu plant is expected to go into operation.

In order to facilitate the transport of crude and products along the shallow Moesi River a "Mulberry pierhead," part of a Mulberry harbor used in the late war, was anchored as a floating loading berth opposite Muntok, capital of the tin island of Bangka. By means of this pierhead big tankers are able to discharge or load part of their cargo into or from shallow-draft vessels, which enables them to sail up the Moesi River.

Up to the present time activities have not been resumed in the Pangkalan Brandan refinery. The refinery and also the tank installation at Pangkalan Susu were seriously damaged, so that the oil installations are considered a total loss.

The accompanying graphs and chart show that the Group's postwar developments are still far from attaining the 1941 level. They will certainly do so, once political stability and general safety, so indispensable to the oil industry, have been restored.

Algeria Plant Opened

A small topping plant and the first petroleum refinery ever built in Algeria in French North Africa was officially opened recently at Sidi Aissa near Aumale.

The installation will process about 225 bbl. daily of crude from production which has been developed in the area over the last 2 years. The location is about 50 miles southeast of Algiers.

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AGIP Accelerates Petroleum Activities in Italy

No. 3 operation, Ricerche e Sfruttamenti, Cantiere di Cortemaggiore. (Photo, Fototecnica Publifoto.)

Oil activities in Italy have been stepped up appreciably by Azienda Generale Italiana Petroli (AGIP) during the last few years. As a result of its program AGIP produces much of Italy's oil and gas. Although it is not the only company engaged in oil production and exploration in Italy, AGIP represents a major factor in the nation's expanded oil and gas output. The accompanying article was prepared by the management of AGIP for this annual International issue of The Oil and Gas Journal.

ORGANIZED in April 1926, AGIP took over exploration and production activities for the account of the state in February 1927. By 1931, it was producing 8.6 per cent of Italy's total crude-oil output and by 1949 it was producing 40.23 per cent of the national total.

In 1937 AGIP produced 2.5 per cent of Italy's natural gas and by 1949 it was producing 45.6 per cent.

Production by AGIP is expected to reach 60 per cent of the entire national output, both in oil and in gas. During the month of November 1950, for instance, its production of natural gas amounted to 70 per cent of the total produced in Italy.

Activities of AGIP are conducted in the north, central, and the south parts of Italy as well as the Island of Sicily. However, during 1950 development has been concentrated in the plains of Padana.

Exploration activities are being developed, particularly in the Padana Valley, where in recent years three important structures — Ripalta, Caviage, and Cortemaggiore—have been located and drilled by AGIP (see accompanying map). Of these, Cortemaggiore is the most important. It is located in the province of Piacenza, where there is a gas field with a substantial amount of high-quality condensate. The extent of this field can only be ascertained through further drilling.

The exploitation activities so far conducted in Italy may be classified as affecting three types of areas:

1. Zones where there is definite knowledge of the presence of gaseous and liquid hydrocarbons.
2. Those where shows or seepages of oil and gas have been found.
3. Zones where geological conditions offer prospects for further exploration.

Producing and Discovered Fields

Caviage.—This gas field, discovered in 1914, currently has 13 producing wells and 4 wells drilling. Average well depth for the field is 5,250 ft. Production is from upper Miocene sand.

Up to November 1, 1950, the field had produced 8,827.5 million cubic feet of gas and 263,880 gal. of condensate. Its daily potential is about 39 million cubic feet of natural gas and 1,100 gal. of condensate. A typical analysis of Caviage field gas is given in Table 1.

TABLE 1—ANALYSIS OF CAVIAGE FIELD GAS

Component—	Vol. per cent
Methane	95.85
Ethane	1.40
Propane	0.45
Butane and isobutane	0.15
C_5 plus	0.15
Nitrogen	1.80
CO_2	0.20

TABLE 2—DISTILLATION TEST, CAVIAGE CONDENSATE

Temp. (°C.)	Vol. per cent
70	1.3
100	3.5
130	8.0
160	31.5
190	53.0
220	75.0
250	90.5
Recovery, per cent	96.5
Residue, per cent	2.5
Loss, per cent	1.0
End point, °C.	226
I.b.p., °C.	36

Ripalta.—Discovery of this gas field was made in 1949. Currently there are four producing and three drilling wells in the field with gas production

This modern rotary rig, drilling at Cortemaggiore field, has its draw works, internal-combustion engines, and derrick floor all shrouded to offset inclement weather conditions. (Photo, Fototecnica Publifoto.)

to November 1, 1950, totaling 2,012.7 million cubic feet. Unlike Caviage field this one produces little or no condensate. Production at an average depth of 5,315 ft. is from upper Miocene sand. Analysis of gas from this field is given in Table 3.

TABLE 3—TYPICAL ANALYSIS OF RIPALTA FIELD GAS

Component—	Vol. per cent
Methane	98.60
Ethane plus	0.60
Nitrogen	0.80
CO_2	trace

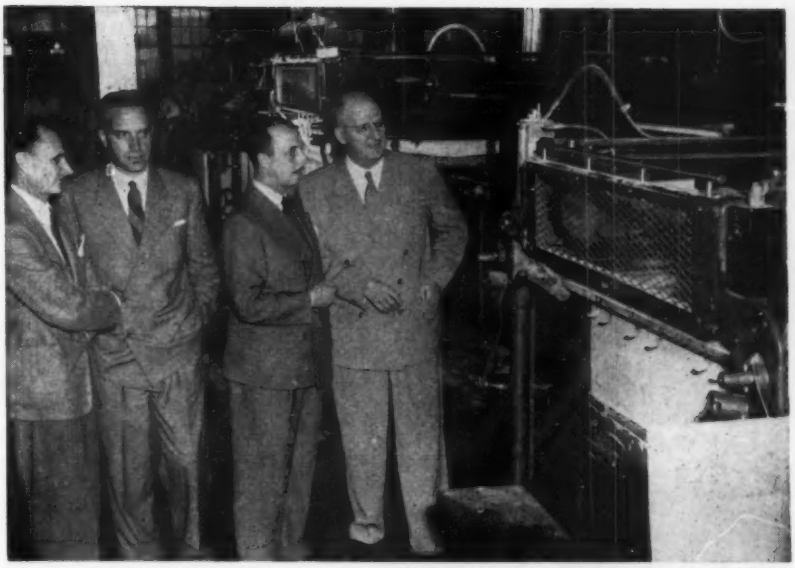
Cortemaggiore.—This field with 14 producing wells was discovered in 1949. Currently six wells are being drilled, one of which will be taken to a depth of 11,155 ft. Average depth of producing wells in the field is 5,415 ft. and producing formation is upper Miocene sand.

Cumulative production from Cortemaggiore field as of November 1, 1950, is 714.5 million cubic feet of natural gas, 125 bbl. of crude oil, and 36,750 gal. of condensate.

A natural-gasoline plant is being built at Cortemaggiore, for processing approximately 106 million cu. ft. per day of casing-head gas. This plant is of the absorption-refrigeration type. It will be put in operation about the middle of 1951 enabling separation of L.P. gas and other liquid fractions. Composition of gas from this field is given in Table 4, gasoline distillation in Table 5, and oil distillation in Table 6.

Podenzano-St. Giorgio fields.—These fields were discovered respectively in 1935 and 1942. Currently there are 19 flowing and 3 pumping wells in both fields. Average depth of the wells in Podenzano are 2,300 ft. and those in St. Giorgio field are 3,775 ft. Producing formation is an upper Miocene sandstone with sand-stone-sand streaks (lower Miocene). Total production up to November 1, 1950, for both fields is 3,531, million cubic feet of natural gas and 48,510 bbl. of crude oil.

Besides the three foregoing fields which are the most important, AGIP is producing from fields of secondary importance located in northern Italy (province of Parma), and South Central Italy (Tocco-Cassauria, Ripi, and Tramutola). Small production of oil and gas is also obtained in Sicily (Giotto).



A.G.I.P. VISITORS.—Members of the Azienda Generale Italiana Petroli were in this country during the spring to let contract for construction of a $2,500,000 natural-gasoline plant in the Po Valley. Here they are shown with C. O. Willson, right, editor of The Oil and Gas Journal, examining one of the new presses in the Journal's mechanical department. Left to right: Prof. Giorgio Roberti, consulting chemist; Dr. Cesare Gavotti de Castellano, petroleum engineer; and Dr. Piero Verani-Bergucci, technical director. The three visited oil installations in several parts of the United States.

Pipe Lines

The pipe lines now in operation as well as those in construction or proposed lines in Italy are shown on the accompanying map. Both construction and operation activities are under AGIP's associate company,

TABLE 4—TYPICAL ANALYSIS ON CORTEMAGGIORE FIELD GAS

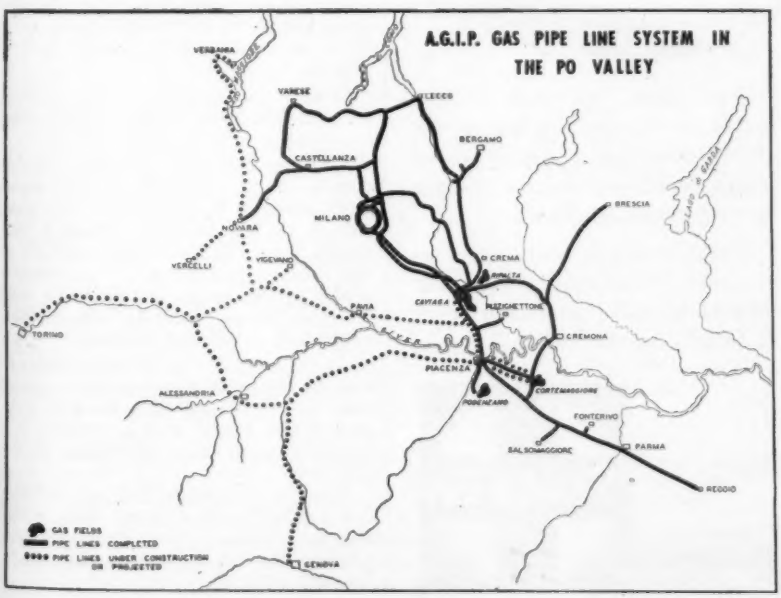
Component—	Vol. per cent
Methane	91.0
Ethane	4.4
Propane	1.5
Butane and isobutane	0.8
C_5 plus	0.6
Nitrogen	1.7

TABLE 5—DISTILLATION DATA ON CORTEMAGGIORE FIELD GASOLINE CONDENSATE

Temp. (°C.)	Vol. per cent
50	9.5
80	25.5
110	55.0
140	75.0
170	87.0
200	91.7
Recovery, per cent	94.0
Residue, per cent	2.5
Loss, per cent	3.5
End point, °C.	206
I.b.p., °C.	29

TABLE 6—DISTILLATION ON CORTEMAGGIORE CRUDE OIL

Temp. (°C.)	Vol. per cent
50	2.5
100	22.0
150	50.0
200	67.5
250	78.5
300	86.5
350	91.5
I.b.p., °C.	30
End point, °C.	370
Recovery, per cent	95



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Societa Nazionale Metanodotti (S. Na.M.). The lines now under construction are to be placed in operation early in 1951. The proposed lines are to begin construction in 1951 and the work is to be finished in 1951 and 1952. Normal working pressure for all lines is about 825 psi.

For the time being, the system now in operation consists of a main line and two branches towards the north (Caviage - Milano - Cesano - Maderno) and Credera-Rivolta-Adda-Seregno-Castellanza-Novara, 182 km.; and the line from Caviage-Ripalta to Bergamo-Lecco (102 km.). The system towards the south consists essentially of the main line Caviage-Piacenza-Parma-Reggio-Emilia, and a small diameter branch for transporting the production from Podenzano-St. Giorgio and Cortemaggiore. Also a short branch line Cortemaggiore-Piacenza.

Capacity Limitations

Capacity of the northern system which traverses the most industrialized section of Lomardy (considering the possibility of retiring from service the side branch line) amounts to about 100 million cubic feet per day. This capacity is greatly limited by the possibility of gas consumption and by the capacity of the southern main line which recently has been expanded by adding the 7-in. Cortemaggiore-Piacenza line (24 million cubic feet per day).

Because of the expense involved in building the gathering lines from the producing fields (Cortemaggiore, Caviage, and Ripalta), recently completed, it will be barely possible to effect the joining of the Credera-Seregno line to the main Caviage-Bergamo line, and to close the ring Castellanza-Varese-Como-Erba-Lecco. As for the area southeast and north of Milan, it will be possible to tap the present main line now under construction and thus complete a distribution system, looped so that continuous service is assured to the consumers in that region.

Within the next few months will be completed the branch Casalbuttano-Brescia, now in construction.

Work on two new gas lines (Pavia-Casale - Torino and Tortona - Genoa) will be begun in early 1951. This line, joined to another line running between Tortona and Casale, which is fed from a gathering line connected with Cortemaggiore and Caviage, will transport approximately 195 million cubic feet of natural gas daily.

At the completion of the construction program, the gas systems operated by AGIP and S.Na.M. will consist of 840 miles of pipe with a capacity of more than 353,000,000 cu. ft. per day.

Azienda Generale Italiana Petroli is a capital stock company with headquarters in Rome, C. C. Postale-Rome 1/2294. Capital stock is 1,000,000,000 lire, all paid in.

Drilling equipment in Lacq field, southwestern France.

France's Lacq Field

Discovery well initialed 75 bbl. of water-free oil per day on pump. Four wells are now drilling, one of which has already found oil in commercial quantities but is being carried deeper to test older horizons.

LACQ oil field, discovered in January 1950, is located in southwestern France, near the village of Lacq, 25 km. west of Pau, the capital of the ancient province of Bearn, at the foothills of the Pyrenees.

Societe Nationale des Petroles d'Aquitaine 1 Lacq, the field's discovery well, was drilled on a seismic prospect outlined by the Campagnie Generale de Geophysique de Paris. This discovery well was the sixth hole drilled on a 2,800,000-hectare (1,133,000-acre) tract granted to the SNPA in 1941.

SNPA 1 Lacq found production at 635-m. (2,083 ft.) depth, 537 m. (1,761 ft.) subsea. The well initialed 12 cu. m. (75 bbl.) of water-free oil per day on pump with a gas-oil ratio of 7 cu. m. of gas per cubic meter of oil. The well was drilled to a depth of 695 m. (2,280 ft.).

Societe Nationale des Petroles d'Aquitaine's Lacq field is located south of Bordeaux and near the Spanish border.

By the first of October 1950, seven wells had been drilled on the structure: six producers (four flowing and two pumping) and one dry hole. There are now four wells drilling, one of which has already found oil in commercial quanities but is being carried deeper to test older horizons. Daily average production for the field is 350 metric tons (approximately 2,000 bbl.) with a water content of 1.3 per cent.

Geology.—The Lacq anticlinal structure is located north of the Puyoo fault, in the gradation zone between the Flysch (a very thick series of sandstones, marls, and shales of older Cenozoic age well developed in the western Alps) and the Continental Shelf facies. On the surface are unconsolidated clays and gravels of Miocene age. These Miocene beds are horizontal and vary in thickness from 200 to 300 m. (650 to 1,000 ft.), and rest unconformably on the marly clays of the Eocene-Ypres. Another unconformity has been indicated between the Paleocene and the Upper Cretaceous (Campanien). This formation is composed of calcareous marl bearing Globotruncana and a great number of Lagena. The basal portion of the Campanien, which forms the reservoir, consists of fractured dolomitic limestone.

Reservoir features.—The producing formation is a limestone which is present in two distinct forms: In certain sections it is a marly chalk, slightly dolomitic and porous. In other sections it is crystalline, heavily dolomitic and porous, compact but fractured. Wells located in the fractured limestone zone have a much greater initial producing potential than those located in the porous zone. Initial bottom-hole pressure was 61.3 kg. per sq. cm. (870 psi. at the 522 m. (1,702 ft.) level. This pressure has varied but little in the subsequently drilled wells and has led operators to believe that there is an excellent system of communication between the fractures and the limestone mass. The oil is under-saturated and there is no gas cap on the structure.

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The limestone porosity ranges from zero to 28 per cent. However, because of the heterogeneous character of the rocks it is impossible to arrive at a mean value at the present stage of development of the field. Likewise, it is not possible to give a significant average for water saturation of the cores.

By electric logging, core analysis, and results of drill-stem tests made of the Lacq wells, it has not been possible to determine the net surface contact of water and oil. Definitely, there is a transition zone in which the proportion of oil diminishes while the water increases with depth. The depth beyond which this zone is considered as ceasing to produce oil, is at about 600 m. (1,970 ft.).

Well conditions.—There are six producing wells: SNPA 1, 2, 4, 5, 7, and 9 Lacq. In the northern part of the field 10 Lacq is producing salt water. SNPA 3 Lacq, being deepened in order to test lower horizons, is now drilling below 1,875 m. (6,150 ft.). Wells Nos. 6, 8, and 11 are now drilling.

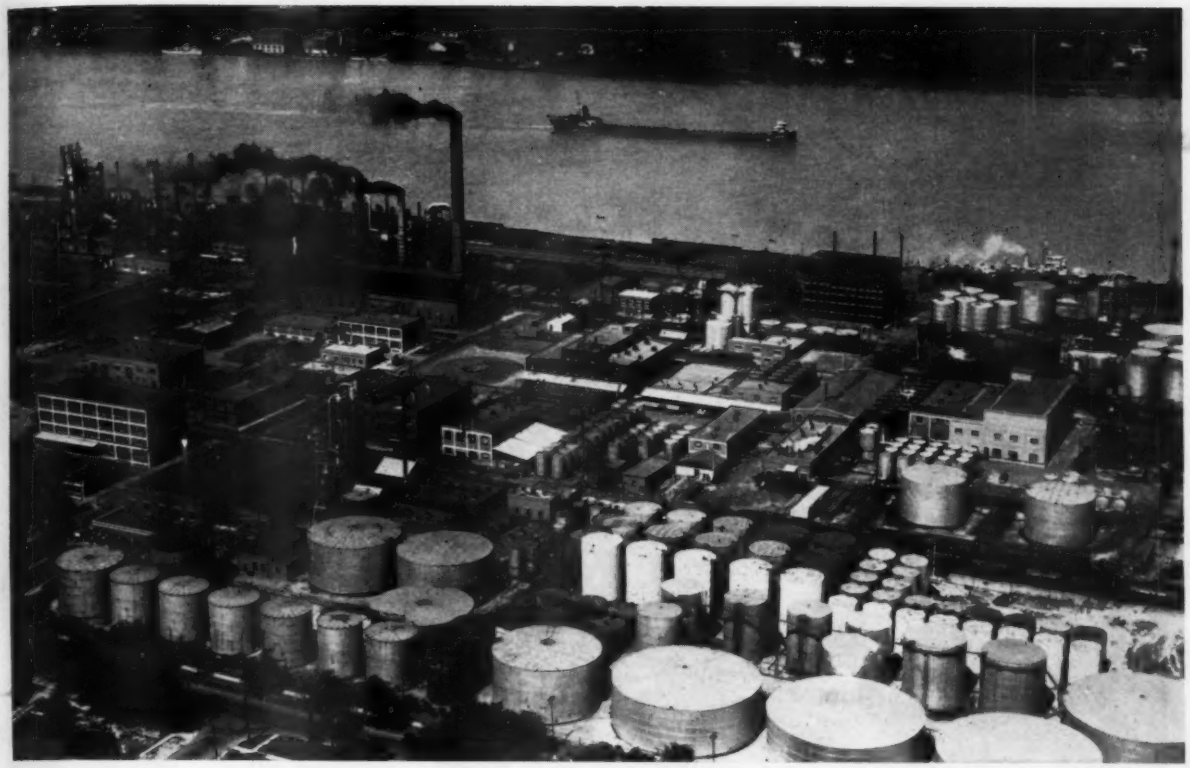
Producing wells are cased to total depth. Two wells, 1 and 5 Lacq, which are subject to flow by heads, had to be equipped with a perforated liner through the thickness of the producing formation.

Water production.—The field is producing little water — about 1.3 per cent. One well produces about 25 per cent and a conventional bottom-hole cementing job was made to effect a water shutoff. However, the well continued to produce an excessive quantity of water. Further cementing operations in water-producing wells are anticipated. Also, it has been proposed to acidize or shoot the less-productive wells.

Characteristics of the oil and gas.—Lacq field produces a mixed-base crude which is classified as a naphthenic-paraffinic oil of 0.925 specific gravity at 15° C. (55° F.) and 36° Engler viscosity at 20° C. Sulfur content of the crude is 3.89 per cent. Paraffin content is 3.1 per cent. This oil is refined at the Pauillac refinery. It yields 10.5 per cent gasoline, 21 to 22 per cent gas-oil which is being used at the present time as fuel oil after blending it with a cut from another crude.

Gas produced with the oil is a gas very rich in liquid hydrocarbons, containing about 300 g. per cubic meter of condensable fractions at standard conditions of pressure and temperature. The production of natural gasoline by activated carbon (adsorption) is to begin soon.

Production and transportation.—By October 1, 1950, the field was producing about 350 metric tons of oil per day. A group of separators and stock tanks with a capacity of 1,320 cu. m. (8,300 bbl.) has been installed near 4 Lacq, at the center of the present state of development of the field.



Canada's largest refinery, a section of which is shown here, is located at Sarnia, Ont.

Progress Report on Prairie Petroleum

Year's end will see 700 oil wells completed, production potential of 142,000 bbl. daily, and reserves of around 1,100 million barrels

ONCE again the Canadian oil industry can label the year which is now closing as "the most active in its history." New records have been set in crude-oil exploration and production, in transportation, and in the volume of products delivered to the consumer. Finally, in addition to holding its general prices at a level that is reasonable in comparison with other prices and with the earnings of Canadians, the Canadian industry has been able to pass along price reductions to prairie consumers entirely as a result of the Canadian development.

While full statistics are not yet available, estimates towards the end of the year indicated that some 140 million acres of prospective oil land were held under lease or reservation —a rise of more than 20 per cent over the 115 millions held a year earlier. There were 125 geophysical parties in the field compared with 105 in 1949, and expenditures on exploration and development were running at an annual rate of 150 million dollars, compared with 100 million in 1949.

Drilling activity followed the general trend upwards with approximately 700 oil wells being completed during 1950. This compares with 580 wells for 1949.

In relation to the scale of operations, the additions to potential production and reserves in 1950 have been comparatively small. Reserves will end the year, it is expected, at around 1,100 million barrels compared with 900 millions in 1949. Production potential in MER will be in the neighborhood of 142,000 bbl. daily, compared with about 115,000 at the end of 1949. The comparatively small improvement in reserves and potential is attributable to the poor luck experienced in the first half of the year.

Until midyear, 1950 resulted mainly in a few discoveries of gas and heavy oil, and it was not until the discovery of the Acheson pool near Edmonton that any substantial additions appeared likely this year. Acheson, Big Valley, and one or two other discoveries made in the latter part of the year appear to hold considerable promise and some estimates indicate that they may push the reserve figure comfortably above the 1,100 million barrels mentioned.

Actual production from the Canadian fields continued to labor under the handicap of inadequate market outlet. Although production topped the 100,000-bbl.-daily mark in the fall, equivalent to nearly one-third of Canada's petroleum requirements, the production peak reflected the requirements to fill the new Interprovincial pipe line, and in part to make up for short runs during the recent Canadian railway strike. The "real" market for Canada's prairie oil was actually running closer to 80,000 bbl. daily than 100,000 at the close of the year.

The method of restricting prairie oil to the available market which was in force throughout 1950 was basically similar to the arrangement which was instituted about the middle

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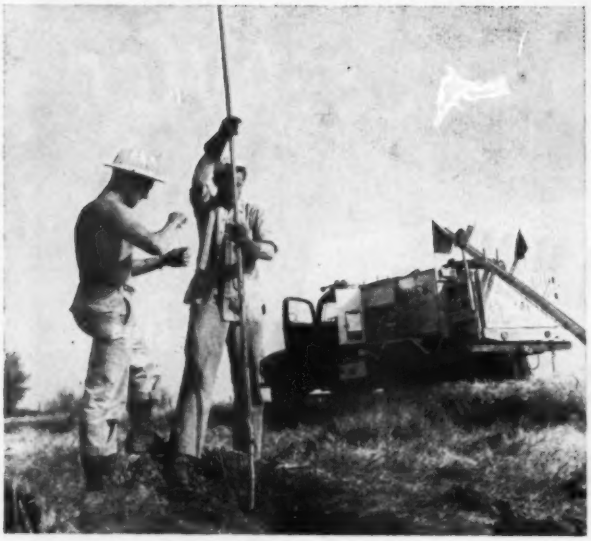
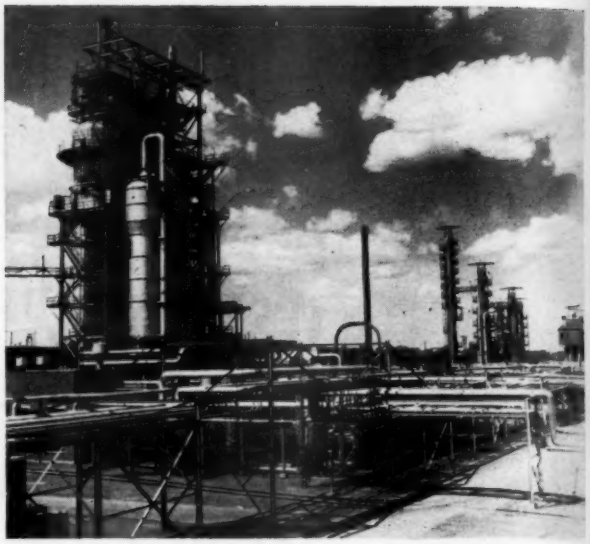


Today there are 125 geophysical parties employed in Canadian exploration operations.



A view of Canada's first fluid catalytic cracking unit, located in Imperial's plant at Montreal East.

of 1949 when prairie supply first outran prairie demand. This was a system of "voluntary prorationing" which had the approval of the provincial government and under which buyers of petroleum would take equal quantities of oil from each of their respective suppliers in a given field. The amount produced from a given well, therefore, has depended on the requirements of the particular buyer with whom the well operator has contracted.

Although this quota system of prorationing is still in effect, the industry through the Western Canadian Petroleum Association, has gone on record as favoring a governmental plan of prorationing which would take ratably from all producers in a field and from all fields in the area regardless of the ultimate destination of the crude.

But regardless of the system of prorationing in force, the problem of finding adequate markets will apparently remain for some time. Some elements of the industry have pointed out that development drilling, which is compulsory under the terms of government leases, tends to intensify this problem, and that some modification of the current provisions would be desirable in order to stress wildcatting.

Pipe Line Completed

Meanwhile, the first major stage in widening the market for prairie oil is nearing completion. The 1,127-mile Interprovincial pipe line from Redwater field to Superior, Wis., has been completed, and has linked the major prairie refining centers (with the exception of Calgary) to the oil fields, by direct feeder lines at Regina and by spur lines to Moose Jaw, Brandon, and Winnipeg. The world's two largest fresh-water tankers, each of which will carry approximately 5,000,000 bbl. in the open season of navigation, have been launched at Ontario shipyards, while new docks, storage facilities, and other equipment are in their final stages at Superior, Wis., and Sarnia, Ont., the latter being the initial eastern destination for prairie crude.

The construction of three new refineries, two at Edmonton and one at Winnipeg, together with expansion of existing refineries in the prairies, is already in progress with the result that 1951 should see the prairies equipped with refining capacity adequate for the local demand for finished products. This construction program indicates a prairie demand of up to 90,000 bbl. daily.

In addition, the transfer of a refinery from Cutbank to Superior will provide a further market for some 5,000 bbl. daily, while the initial plans will permit an average shipment in 1951 of 35,000 bbl. daily to Ontario refineries.

Completion of the present facilities will therefore provide an outlet for between 115,000 and 120,000 bbl. daily of prairie crude.

Subsequently, the modification of the present system through doubling the pumping stations on the Interprovincial line, construction of additional storage, additional tankers, and additional refinery capacity, could build the total market up to around 200,000 bbl. daily. If a market of this size is realized, it would probably be made up roughly of some 90,000 bbl. prairie, 90,000 bbl. Ontario, and perhaps up to 20,000 bbl. at Superior.

But it hardly seems likely that the facilities to handle 200,000-bbl. volume of crude could be completed before 1952 at the earliest, despite

This plant at Devon, Alta., processes wet gas from Leduc field wells.

the fact that the Canadian development has established a number of speed and distance records in the last few years. The initial facilities for marketing 115,000 bbl. plus will reach completion approximately 4 years after the first major discovery at Leduc in 1947.

Aside from the rapidity of the Canadian development, one of its most interesting features is that it is taking place in a country which ranks second only to the United States in per capita oil consumption. Moreover, it has taken place during a period in which Canadian demand has been growing extremely rapidly. In the last 10 years gasoline demand has doubled and heating-oil demand has increased 3½ times. From 1939 to 1949, total Canadian petroleum consumption increased 112 per cent as compared with 72 per cent for domestic demand in the United States, that is at almost 1½ times the American rate of growth.

Expansion Is Industry Wide

This has meant that in addition to becoming an important producer of crude for the first time, Canada has had to advance at full throttle in the fields of crude transportation, manufacturing, and marketing.

At the manufacturing level, there has not only been the problem of over-all expansion, but that of harmonizing the conflicting demand for more heating oil and higher-octane gasoline. (During the war, the smallest emphasis placed on synthetic rubber and aviation gasoline in Canada slowed down the Canadian progress towards higher octane rating in comparison with that achieved in the United States.)

With regard to over-all refining capacity, the estimate for 1950 places Canadian capacity at 319,000 bbl. daily, roughly 6 per cent above the 300,000 recorded for 1949. Further expansion projects, either announced or rumored, indicate a growth in 1951 of at least 10 per cent in total capacity, and possibly a good deal more.

At least four of the prairie construction programs will involve the fluid catalytic process, a process which already is being used at the four major refineries at Montreal. One other refinery in central Canada will also adopt the fluid process and there have been as yet unconfirmed rumors of still others adopting the technique.

Canada's total demand is currently running in the neighborhood of 355,000 bbl. daily, with the result that the current 319,000 bbl. of installed refinery capacity, together with the expansion taking place, should result in a smaller gap between capacity and demand by the end of 1951. At the same time, the growth of catalytic and other high-octane techniques has been steadily adding to the quality of gasoline. Research octane number for premium-grade gasolines was 86 in January 1949, 87.2 in January 1950, and 88.1 at September 1950. At corresponding dates, the research number for reguar-grade gasoline has averaged 79.8; 81.5; and 82.6.

The race to improve quantity and quality has, of course, been accentuated by the rapid growth of over-all demand in Canada. Petroleum is an ideal form of energy for Canada where long distances, large-scale farming, and a continuing substantial pioneering activity feature the life of the country. Total petroleum demand in 1950 is expected to run 11 per cent higher than in 1949, continuing a process which has added approximately 10 per cent or more each year since the end of the war.

But in addition to the problems of total supply and gasoline quality, has come a very sharp increase in the demand for middle distillates. As compared with an 11 per cent growth in total crude and products demand, and a 9 per cent rise in motor gasoline, the middle-distillate group as a whole is expected to show a 23 per cent rise in 1950 over 1949.

This increase in middle-distillate demand reflects in part the increased requirements for lubricating oils and of diesel fuels for the gradual dieseli-

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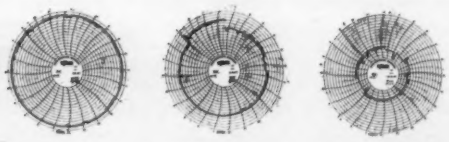

August 10: **Bare Tank** *100,000 barrels* Steam Consumption: **13,500** *pounds per hour*

September 14: **Side Walls Insulated** Steam Consumption: **9,800** *pounds per hour*

December 21: **Roof Insulated** Steam Consumption: **3,300** *pounds per hour*

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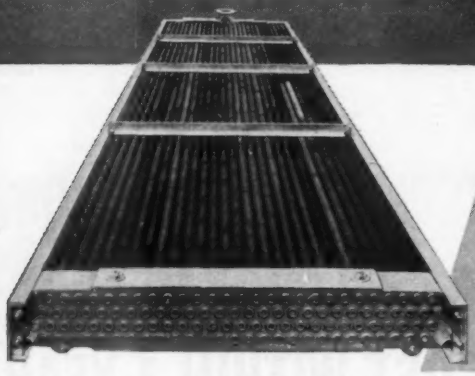
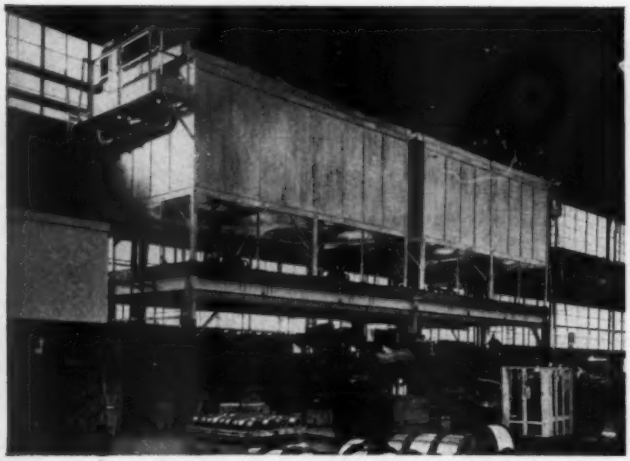
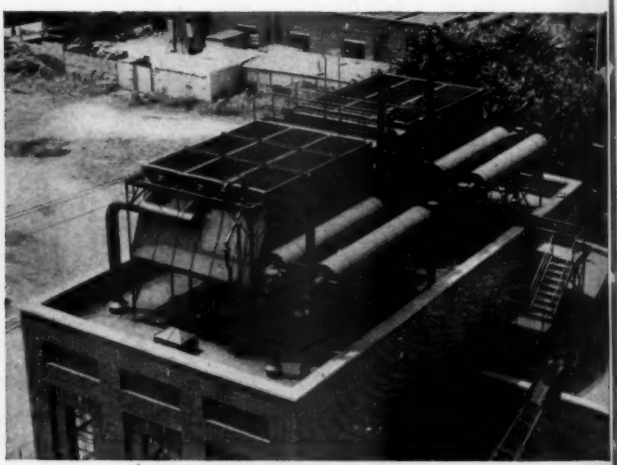
AI



G-R K-Fin Air-Cooled Sections used in the Fin-Fan Exchanger



Fin-Fan Exchanger installed within a building



Fin-Fan Exchanger installed on a roof

Large Fin-Fan installation on the ground

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GRISCOM-RUSSELL: PIONEERS IN HEAT TRANSFER APPARATUS

zation of Canada's railways, but is mainly attributable to the rapid shift to heating oils in Canadian homes. Heating-oil demand, as mentioned above, is running 3½ times the figure of 10 years ago.

Oil for Space Heating

All the considerations which have led to the rapid development of oil heating in the United States apply with increased force in Canada, owing to the more extreme winters in a large part of the country. The figures available are somewhat sketchy, but it appears that one out of every six Canadian homes is heated by a space heater or power burner, and that perhaps one out of every four homes with central heating now uses oil as a fuel.

The problem of devising suitable measures to meet this heavy demand is also of a peculiar importance in Canada. In common with other parts of the industry, operations—and the operating margin—are now to a considerable extent at the mercy of the weather. The industry must also gear operations to supply 1 bbl. of middle distillate for every 1.6 bbl. of gasoline. The former norm was more than two parts gasoline to one of middle distillate.

Three basic steps have been taken or are in prospect for this situation. The first has been imports from the United States and from warm-climate refineries where the demand for middle distillates is not as acute as it is in Canada. The second remedy has been the adaptation of cracked gas oil for heating use. Considered, but not as yet adopted, has been some catalytic method of reforming distillate gasoline for higher octane, thus relieving the middle-distillate group from the need of providing such large quantities of cracking feed stock.

The very rapid growth of demand for heating oils has, of course, been reflected at the marketing level. Peak tank-wagon deliveries in many parts of Canada are now during the winter months in contrast with the former summer peak. Major additions to storage at bulk stations (as well as at refineries) have had to be made to meet the new seasonal pattern which requires the running of a large part of the heating oil in summer for winter-time consumption.

Refinery Readjustment

The new emphasis on heating oils, and the correspondingly smaller proportion of total cost that can be borne by white products, might seem to imply the possibility of new price relationships among the various petroleum products. It is possible, however, that the gradual readjustment of Canadian refineries to the new pattern will not involve any important changes at the consumer level, other than those caused by fluctuations in world prices. This situation would be possible since consumer prices already reflect the cost of importing middle distillate and in some cases transporting it over considerable distances within Canada. As a result, the potentially higher cost of meeting the middle-distillate demand from domestic refineries might well be balanced by the saving in transport costs on imports.

Generally speaking, the price situation on petroleum products in Canada has been a singularly happy one in 1950. Throughout the country product prices have been kept low relative to the prices of other commodities and to the incomes of the people. The average retail price of gasoline, for example, in comparison with average wages and salaries, is such that a week's average pay will now buy 16 per cent more gasoline than it would in 1946. In terms of consumer purchasing power, gasoline is therefore approximately 14½ per cent cheaper than it was 4 years ago.

While the general Canadian price picture is thus extremely favorable, even greater improvements have been possible in the prairies since Alberta crude began to move by pipe line to prairie refineries in October. This movement made possible reductions ranging up to about 4 cents per Imperial gallon at the consumer level, reductions which will be followed by further cuts next spring and summer when well-head prices drop as a re-

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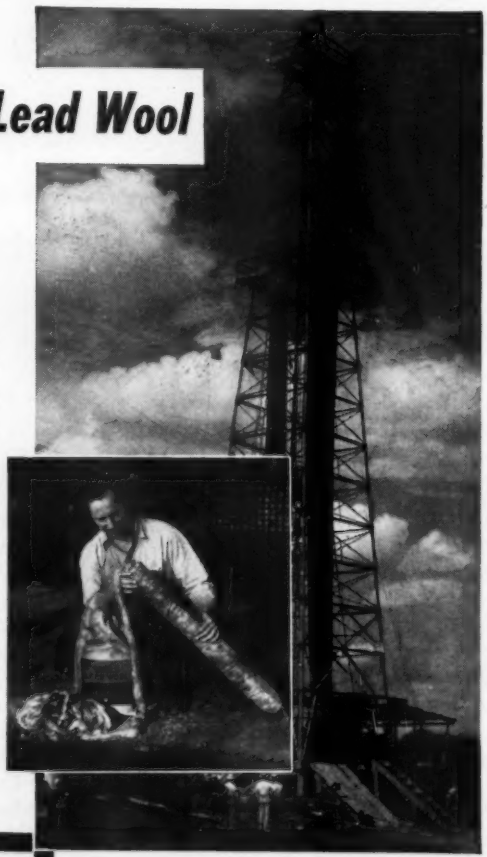

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sult of the movement of crude to the lower lakes. Savings to prairie consumers from domestic oil development amounted to an estimated 30 million dollars in 1949, should total around 35 million for 1950, and are expected to reach about 55 million for 1951.

While the price benefits are naturally most marked in the prairie provinces close to the new crude development, the benefits to the Canadian economy as a whole has undoubtedly been very great. The development is currently improving Canada's foreign exchange position at something over 100 million dollars per annum with a calculated improvement for 1951 in the neighborhood of 145 million. In addition the inflow of capital, largely American, has had a further highly beneficial effect on Canada's exchange position. It is estimated that in the 4 years ending 1950 something like 500 million dollars will have been invested in the development of the Canadian oil industry as a whole. It is impossible to ascertain what proportion of this sum has been in American funds, but it is undoubtedly substantial.

The international aspect of the Canadian development looms extremely large in connection with possible future export markets. It has been suggested that the strategic interests of Canada and the United States, as well as the economic interests of producers and consumers, would be served by trading Canadian oil for dollars in the west and importing dollar oil in the center and east, thus minimizing transport penalties on consumers and producers in both countries.

With the present market facilities capable after modification of handling more than the presently available quantity of crude, this problem appears to be of a rather long-term nature. Yet the continuing high level of exploration activity in Canada indicates that further large additions to crude reserves may soon be discovered.

Portugal to Expand Plant

The Portuguese refining and marketing company, SACOR, has been authorized to go ahead with plans for expanding and improving its plant at Cabo Ruivo, Lisbon.

At a recent special general meeting, the government representative in the company gave assurances that the government would extend the company's license which guarantees it 50 per cent of the domestic market, and would maintain the domestic price structure for petroleum products. Based on this, the meeting authorized carrying out the expansion project.

Several different plans for revamping the refinery have been drawn up in the past.

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Latex Construction Company, heretofore engaged in pipe line construction, is now being liquidated and will no longer be active.

Messrs. Laurence H. Favrot and R. P. Gregory have formed a partnership under the name of Houston Contracting Company for carrying on general pipe line and allied construction work, and solicit an opportunity to bid on such work.

Mr. Geo. A. Peterkin will be associated with the new firm.

Mr. J. W. Sharman has decided to retire from this line of business.

December 1, 1950.

Substantial Increase Shown in Foreign Rotary Rigs Operating

by Dahl M. Duff
International Editor

Late this year there were 40 more rotaries busy in countries outside the U. S. than at the same time last year. Total number reported was 453

THE total of rotary rigs operating in foreign areas the latter part of this year showed a substantial increase over the same period of 1949, and indications point to a continued upturn at least through the first half of next year.

The 453 rigs reported running in November of this year in all areas abroad except Russia, its satellites, and Germany represented a gain of 40 rigs over November 1949. Of these, slightly more than 60 per cent are in South America, mostly Venezuela.

The trend of foreign operating rigs was, as a result of rehabilitation work and industry expansion, steadily upward for the first three postwar years. The total dropped off sharply in 1949 because of the cutback in activities in Venezuela and to a lesser extent in some other countries.

Of this year's increase in rigs, a sizable part is accounted for in Europe and especially in Italy and France. In these two countries, government-supported drilling programs have been considerably enlarged in the effort to find indigenous sources of production.

The gain in the total of rigs operating in South America this year was only 12 over last year. However, reports indicate Venezuela and several other countries will see greater activity after the first of the year as many operating organizations enlarge their programs.

Rigs operating in Venezuela now make up some 42 per cent of all those operating in South America and about 20 per cent of the world total. All three major Venezuelan producers are said to be planning the addition of more rigs next year. An increase of 30 or more rigs next year is anticipated in some industry circles.

Drilling activity normally follows the trend of production, though with often a considerable lag. The all-time record production in Venezuela over the past few months bears out the expectations of increased rigs in operation next year. Generally, however, it is not believed that the total of rigs running in Venezuela will return to the more than 150 operating late in 1948, a level which some feel was in excess of requirements at the time.

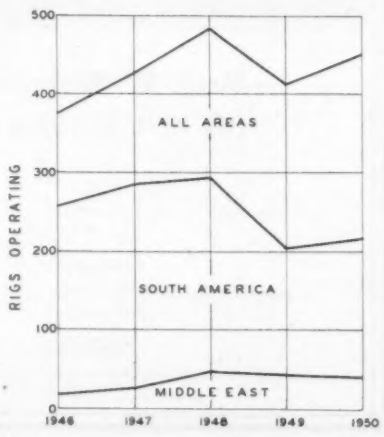
Smaller gains are expected elsewhere in Latin America next year. Petroleos Mexicanos recently purchased six additional rigs which are to be placed in operation shortly. The Chilean Government's ENAP has two more rigs reported en route. The easing of the dollar shortage not only in Latin America but in many other parts of the world has contributed to the improved situation enabling various countries such as Argentina to continue and enlarge their drilling programs.

The slight drop in the total of rigs running in the Middle East reflects particularly the completion of the development program in Kuwait. Wildcatting continues in Syria and on the Trucial Coast. One of the most active areas in the Middle East is in Basrah on the Trucial Coast. The outstanding fact in connection with drilling in the Middle East is that far fewer rigs are required to support the production than elsewhere. This is due to the high productivity of individual wells in the limestone formations and to careful company-wide operation of the producing areas.

Available information indicates an increase of seven rigs in the Far East and southeast Asia region over the last year. Most of these have been added in Japan where new production from deeper horizons has given encouragement to the operating company, principally Imperial Oil Co.

No exact figure is available on the total of rigs running in Germany, though the figure is believed to be approximately 90. Yugoslavia is reported to have nine rigs in operation. Elsewhere in the Communist-controlled areas, including China, no accurate information is obtainable.

FOREIGN ROTARY-RIG OPERATIONS



ROTARY RIGS IN OPERATION

North America

Country—	Nov. 1950	Mar. 1950	Nov. 1949	Mar. 1949
Alaska	4	3	2	2
Cuba	0	0	1	1
Mexico	41	41	37	37
Total	45	44	40	40

South America

Argentina	45	42	42	50
Bolivia	2	2	2	2
Brazil	5	5	5	5
Chile	4	4	4	4
Colombia	13	13	12	24
Ecuador	13	13	13	11
Paraguay	0	0	1	2
Peru	18	10	10	21
Trinidad	26	23	23	22
Venezuela	90	78	92	133
Eastern	(46)	(45)	(49)	(67)
Western	(44)	(33)	(43)	(66)
Total	216	190	204	274

Europe

Denmark	2	0	0	1
England	9	8	9	9
France	30	25	22	22
Italy	23	19	15	15
Netherlands	7	5	5	4
Portugal	2	1	0	0
Spain	2	1	3	3
Total	75	59	54	54

Africa

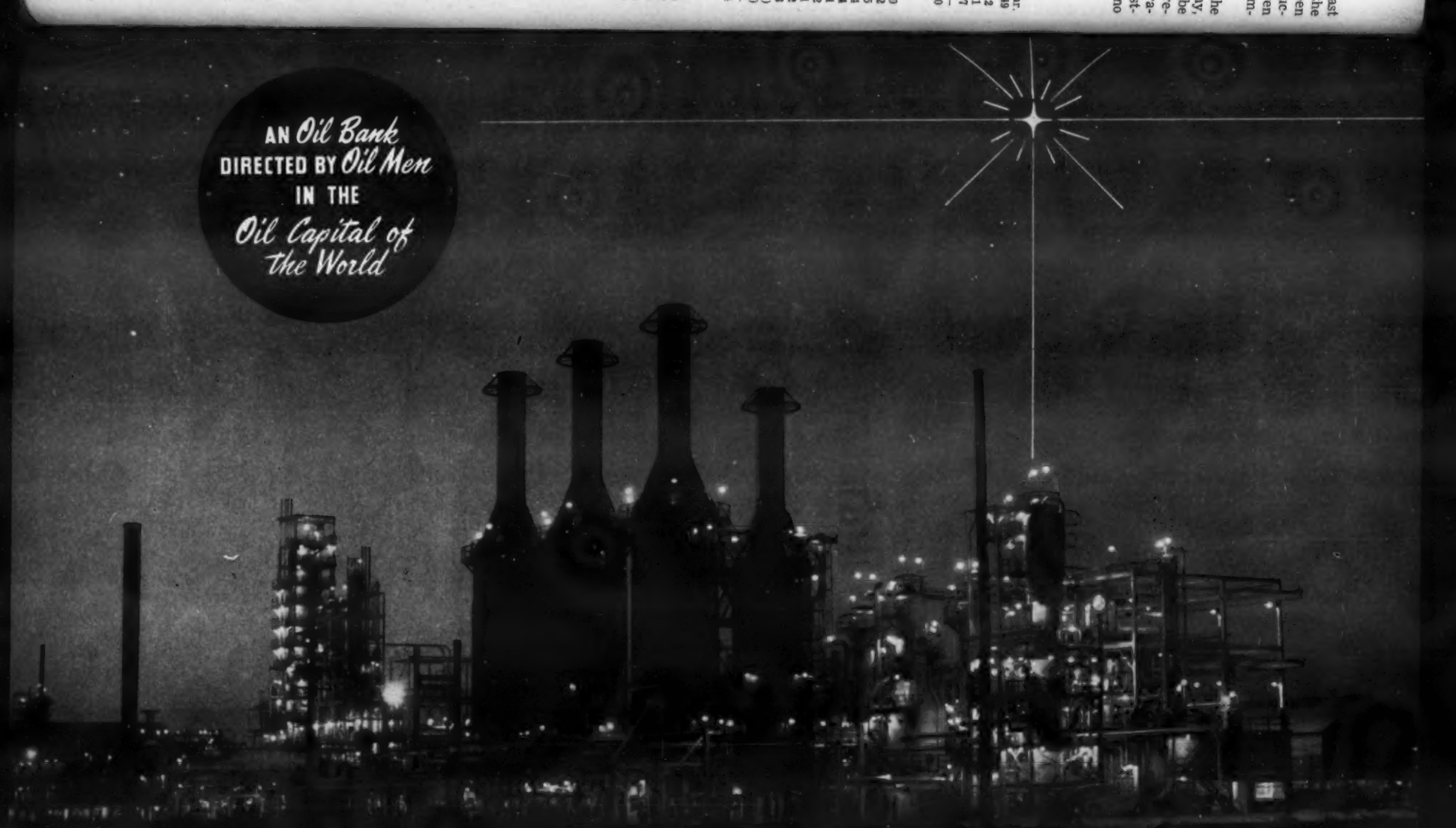
Algeria	5	2	2	2
Egypt	3	6	7	8
Ethiopia	1	1	1	0
French Eq. Africa	3	1	1	1
French Morocco	6	6	6	6
Nigeria	1	0	0	0
Tunisia	2	2	2	2
Total	21	18	19	19

Middle East

Bahrein	2	2	2	2
Iran	8	9	9	9
Iraq	9	6	6	6
Kuwait	2	7	9	9
Lebanon	0	1	1	1
Neutral Zone	1	1	1	0
Qatar	2	2	2	2
Saudi Arabia	5	5	5	7
Syria	1	1	3	3
Trucial Coast	1	1	0	0
Turkey	4	3	3	2
Total	35	38	41	41

Other Asia

Australia	2	1	2	2
Burma	0	1	1	2
East Indies less New Guinea	26	24	24	21
India & Pakistan	10	11	12	12
Japan	15	9	9	9
New Guinea	6	6	5	5
Philippines	2	2	2	2
Total	61	54	55	53
Grand total	453	403	413	481



THE FIRST NATIONAL BANK
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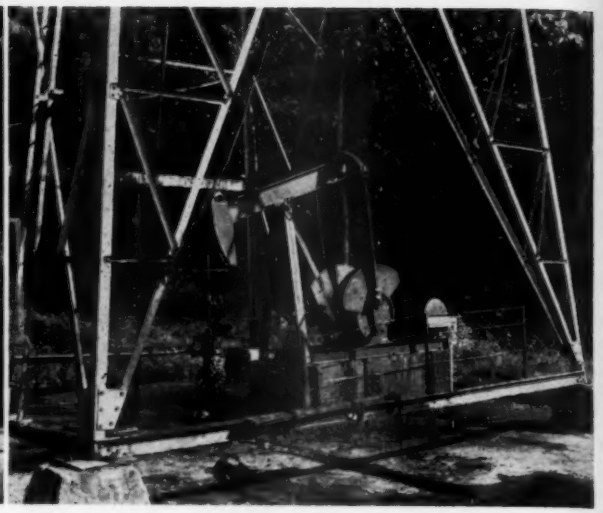
MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

Well-servicing unit being set up for operation, Trinidad Leaseholds, Ltd., Forest Reserve.



Use of electrically powered pumping units in Trinidad oil fields is increasing substantially.

Wildcatting and Refinery Modernization Highlight Activity in Trinidad

BY far the greatest volume of oil in Trinidad still comes from the Miocene sands and all the companies have continued their drilling operations on well-designed spacing programs to exploit these sands. Most of the rival companies have boundary agreements which have been drawn up with an eye to the best principles of conservation. An average of about 24 drilling outfits are engaged upon this work, and total footage averages about 44,000 ft. per month. It is true that some of this exploitation was conducted in the Oligocene (Herrera sands) in the Penal and Barrackpore area, but the results were not uniformly good. The average depth of all wells drilled was about 4,200 ft. last year and there is a general tendency towards deeper and deeper production; the deepest producing well is now over 10,500 ft.

In spite of the fact that total production over the past 3 years has shown little decline, there remains an underlying trend towards a decrease as evidenced by the higher number of producing wells and the continued fall in the proportion of flowing production. It must be realized now that the peak of Miocene production in Trinidad has probably passed. The accompanying map shows the areas of exploitation of Miocene and Oligocene formations, and the producing

The topping unit in Trinidad Leasehold's, Ltd., Pointe-a-Pierre, 70,000-bbl.-daily refinery.

and potentially producing horizons of Trinidad are given in Table 1.

Actual production statistics for the past 3 years in relation to previous years is as follows:

Year	Bbl.
1941	20,506,000
1943	21,385,000
1945	21,093,000
1947	20,520,000
1948	20,111,000
1949	20,694,000

Wildcatting

Drilling for new reserves in Trinidad may be defined as having three main objectives. South of the Central Range exploration has crystallized into an attempt to define the occurrence of the Oligocene (Herrera sands) from east to west across the island. Meanwhile, other wells have been put down to explore the possibilities of oil from the Cretaceous.

North of the Central Range the prospects in Miocene and Oligocene are not considered to be good and exploration is concentrated upon Eocene, Palaeocene, and Cretaceous objectives, particularly the last named.

Of the deep wells drilled recently, only the last one gave indications of oil. Outsteps in 1950 from this last well have not proved very successful. An average of four heavy-duty drilling rigs are continuously engaged upon this wildcatting, and expenditure is at the rate of about $5,000,000 per year.

It may well be asked why Trinidad oil companies still plan further tests; the main reason is that by no means all the possible reservoirs, particularly the Middle Cretaceous, have yet been tested. If these reservoirs are eventually located, geologists hope that they may contain larger quantities of oil than have been found in the present producing horizons; this would justify the greater expense of the deeper and more difficult drilling.

The extraordinarily complex geological conditions in Trinidad not only make wildcatting risks high, but prevent the satisfactory application of the various modern geophysical methods, all of which have been extensively tried from time to time.

Marine Developments

Marine gravity surveys have been conducted off the coast of Trinidad and submarine prospecting licenses have been granted to several companies. The economic problems connected with drilling at sea are under constant review, but it is appreciated that the high initial investment must be balanced by a higher ultimate production than has so far been realized from most of the wells in Trinidad; for the moment drilling in the marine areas will probably be confined to directionally drilled wells located on the seashore.

Drilling Developments

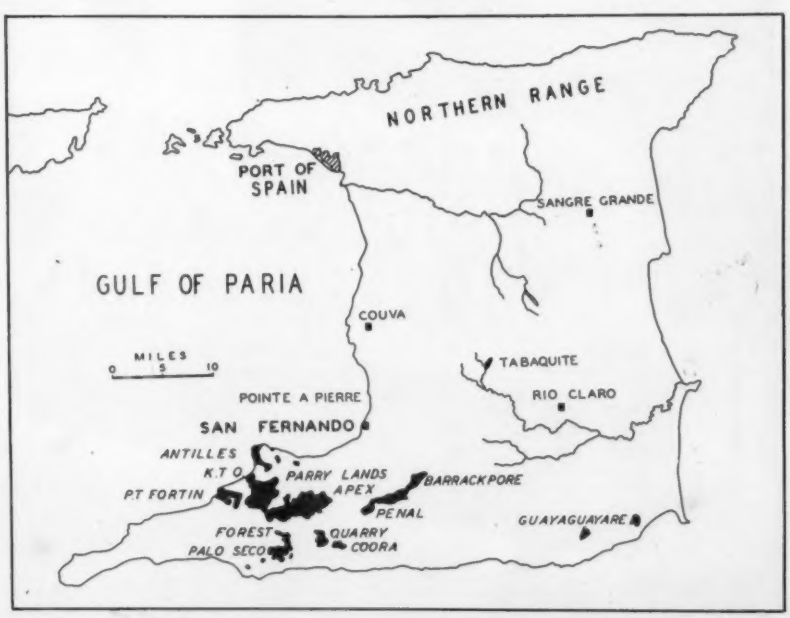
In spite of the finest equipment obtainable, Trinidad drilling conditions still give continued anxiety. The combination of excessive differential pressures in stray sands and pockets, combined with heaving and swelling shales, create the gravest hazards.

The highlight of recent operations has been the development of an oil-base mud which can be loaded with

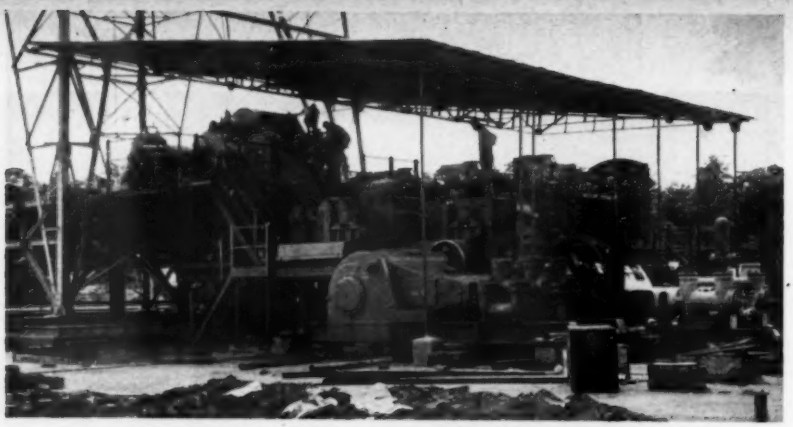
Trinidad Leasehold, Ltd., Forrest Reserve tank battery. Automatic gaging equipment in foreground.

TABLE 1—POTENTIAL AND PRODUCING HORIZONS OF TRINIDAD

Series—	Local subdivision	Oil sands
Miocene:		
Clay-shales and sands	Morne L'Enfer	Morne L'Enfer sands
	Forest	Forest or Lot 1 sands
	Cruse	Cruse sands
Oligocene:	Lengua	.....
Marls, clay-shales, sands and orbitoidal, reef limestones	Golconda	Herrera sands
	Retrench	.....
	Princes Town	.....
Eocene:		
Marls, clay-shales, sands, and reef limestones	Hospital Hill, Navet, Tricentrol	Tabaquite sands
Palaeocene:		
Marls	Lizard Springs	.....
Upper Cretaceous:		
Argilline, marls	Tarouba	.....
Middle Cretaceous	Unexplored	.....



Map of Trinidad showing areas of exploitation, Miocene and Oligocene formations.



Deep-drilling tests in Trinidad require the heavier types of equipment.

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TUBULAR "CLEARSITE" FEED
SF LUBRICATOR

The new, improved McCord Tubular "Clearsite" Feed is the latest development in lubricator visible sight feeds. Less susceptible to clouding, it carries a greater supply of liquid and may be cleaned without removing it from the pump or disconnecting it from the oil line. The McCord "SF" Lubricator provides close and accurate feed adjustments with a degree of reliability that has made this the preferred lubricator in the oil field. The advantages of easy removal of pump units, welded steel tanks, the wide variety of drives, and the new type graduated oil level gauge which provides clearer visibility are McCord features that make the "SF" Lubricator outstanding. Lubricators are in stock and deliveries are prompt.

Lubricator Division
McCORD CORPORATION • Detroit 11, Mich.

barytes sufficiently to hold back heavy pressure, and, at the same time, stops the swelling and caving of the clay shales. A great drawback to this mud was the fact that an electric log could not be run in this medium, but this has been assisted by the use of an induction log. Drilling time has been decreased; more open hole can be carried and casing runs in freely, even if the hole is left open for some days. One company is testing a lime-starch mud exhaustively and another is using oil emulsion.

Exceedingly hard formations have been encountered in the deep Oligocene wells and diamond core bits are now generally used in these horizons.

Wells are completed with gun-perforated and jet-perforated solidly cemented oil strings. Radioactive bullets have been used for locating thin zones at greater depths. High-pressure cementing, gun perforating, electric logging, and well surveying are done almost exclusively by two service companies. A magnatector has recently been brought in by one of these companies, but all other operations, such as bottom-hole-pressure work, mud technology, core analysis, and so forth, are done by technicians employed by the companies themselves.

Production Developments

Pumping equipment, both surface and subsurface, has now become available in adequate quantities from the United Kingdom; however, fishing tools, flow valves and other specialties still figure in United States overseas orders. Operators are particularly satisfied with the new British-made pumping units and subsurface pumps.

At least three crews are engaged upon echometer work for the evaluation and operation of pumping wells; as fluid levels decline, heavier units are being installed and deep winch work can be reduced by accurate fluid-level determinations. Double-drum mobile winches similar to those built in the United States are now being supplied from the United Kingdom. This double-drum model has a power takeoff through a torque converter. Power is supplied for both traction and hoists by a 130-hp. 6-cylinder diesel engine. It is capable of servicing 10,000-ft. wells.

In contrast to pumping methods, one company continues to operate all its artificial-lift wells on the plunger lift system; another company continues the installation of automatic gaging throughout its property with the object of reducing labor costs.

Years of intensive bottom-hole-pressure work have assisted geologists in defining reservoirs which hitherto had been most difficult to correlate by reason of their lenticularity and structural complexity. As more and more knowledge of the gas and oil distribution in these reser-

voirs is accumulated, so a greater stimulus is being given to gas injection and pressure maintenance. Gas collection, distribution, and utilization now occupy an increasingly important place in the production affairs of the oil companies.

Refinery Developments

During the war Trinidad's refineries were expanded to meet the demands for special aviation high-test gasoline; the capacity of the refineries is about 100,000 bbl. per day and the average daily production from Trinidad oil fields is 56,500 bbl. per day. Trinidad Leaseholds, Ltd., is now a major importer of crude oil; it obtains its imported crude oil from Venezuela and Colombia for its refinery at Pointe-a-Pierre. Trinidad's government, realizing the vital interest to the colony of this refining industry, has given its encouragement by making these imports exempt from duty, subject to certain conditions, for the next 23 years. This has enabled executives to make contracts for processing imported crude for many years to come, and has been no small factor in arriving at a decision to go ahead with a $19,000,000 capital expenditure for refinery modernization.

Refinery modifications have been made necessary by the obsolescence of two old cracking plants; the most modern type of fluid catalyst cracking plant with a capacity of 15,000 bbl. is being installed under contract by Foster Wheeler. The new plant will not only give ample cracking capacity but will produce gasoline to meet any specification required by the market. Most of the equipment required for this modernization will be purchased in the United Kingdom and dollar requirements should be relatively small. Executives believe that the increased proportion of gasoline and the improvement in product quality should justify the heavy capital outlay.

Other recent refinery expansions have included the completion of vacuum and blown asphalt plants at Point Fortin (United British Oilfields of Trinidad—a Shell affiliate).

Another recent development is the manufacture of chemicals. A new company called "Tricana" has been formed for the manufacture of soapless detergents, and a refinery now makes its own sulfur and naphthenic acid. The soapless detergents are being shipped to Canada and the United Kingdom.

U. K. Plants Being Enlarged

Two Scottish refineries and a plant in Wales are being expanded to provide increases in daily throughput.

Scottish Oils, Ltd., operator of refineries at Pumpherston and Grangemouth, Scotland, is nearing completion of a new crude-oil distillation unit at the Grangemouth site which will raise the refinery's capacity from 14,000 to 37,000 bbl. daily. A new catalytic cracking unit, with a rated capacity of 10,000 bbl. daily, is scheduled to be installed in the refinery by the end of 1952. The company's Pumpherston refinery operates on both crude oil and shale oil. Input to the plant is split on approximately 30 per cent crude oil and 70 per cent shale oil, with an over-all capacity of 3,700 bbl. daily. Both Grangemouth and Pumpherston are equipped with vapor-phase thermal cracking units.

William Briggs & Sons, Ltd.'s refinery at Camperdown, Scotland, is being equipped with augmented crude-oil-distillation facilities. A 1,000-bbl. unit is now under construction, with completion set for late 1951 or early 1952.

National Oil Refineries, Ltd., is equipping its Llandarcy, Wales, refinery with a 10,000 bbl. daily catalytic cracking unit. Present capacity of the refinery is 60,000 bbl. daily. Completion of the new unit is scheduled for the end of 1952. In addition to crude-oil distillation facilities, the plant is equipped with a 4,000-bbl. vapor-phase cracker and processes for manufacture of lube oils, waxes, and asphalts.

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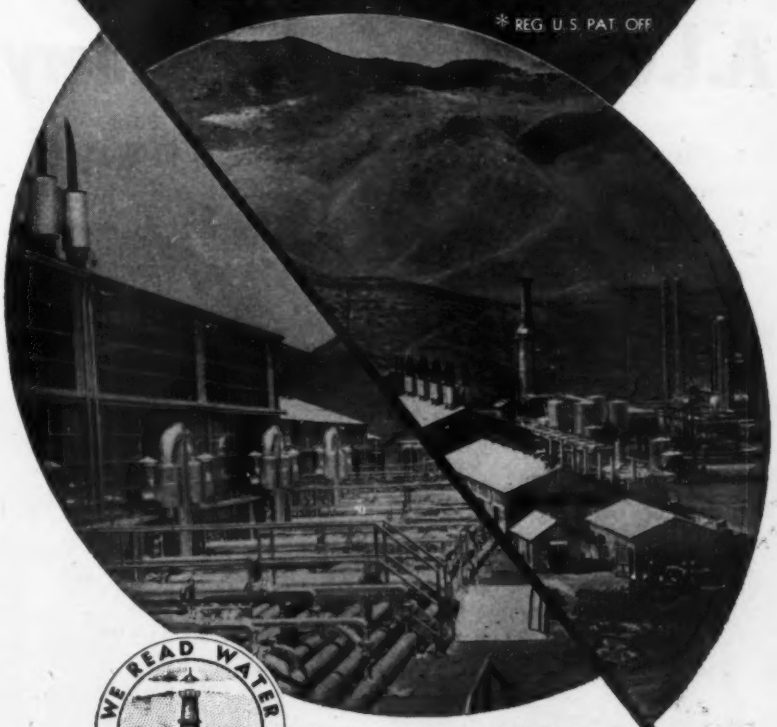

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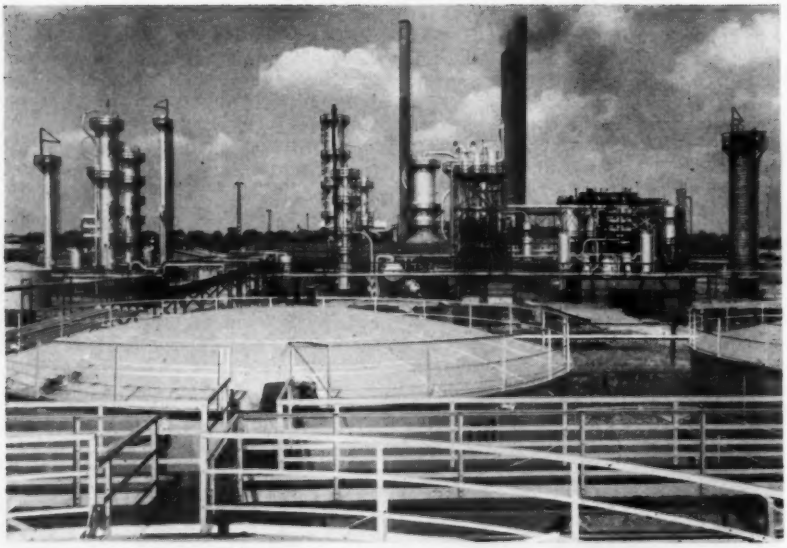


Eurotank's rebuilt Hamburg, Germany, refinery. Severely damaged by wartime bombings, the refinery is now operating at an input rating of 13,000 bbl. of crude oil daily.

Modernization Completed at A.I.O.C. Eurotank Refinery

Plant is now a completely integrated unit with a nominal crude-oil capacity of 13,000 bbl. daily. Main products are motor fuel, gas oil, fuel oil, and asphalt. Plant opened late last September

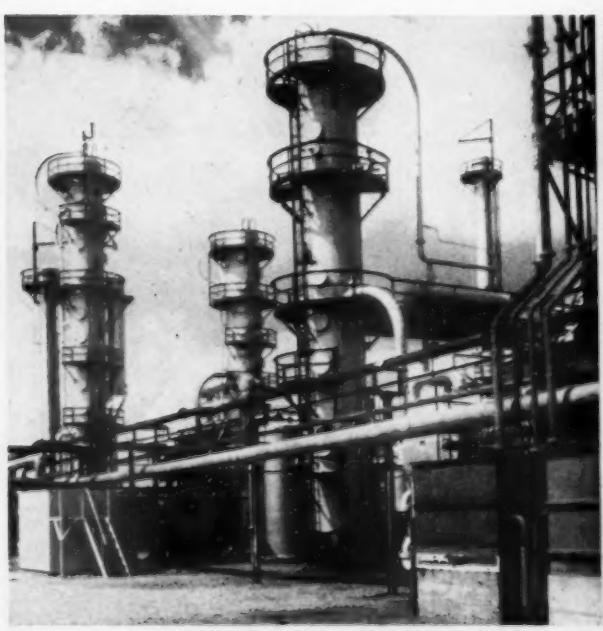
THE enlarged and modernized Eurotank refinery on the south bank of the River Elbe to the west of Hamburg, severely damaged in wartime and purchased by Anglo-Iranian Oil Co., Ltd., late in 1948, was officially opened on September 28. Originally constructed in 1934 the refinery was formed by combining two sites, one used for storage facilities, and the other containing a small plant mainly operated to obtain products for local consumption.

Integrated refinery.—The Eurotank refinery is now a completely integrated unit with a nominal crude-oil capacity of 575,000 tons a year (13,000 bbl. per day). The main process units comprise a topping unit (750 tons or 5,000 bbl. a day); a combination unit (1,200 tons or 8,000 bbl. a day crude input plus cracking and reforming capacity for naphtha and residue from the topping unit); gas-recovery and stabilization plant; and plumbite treaters.

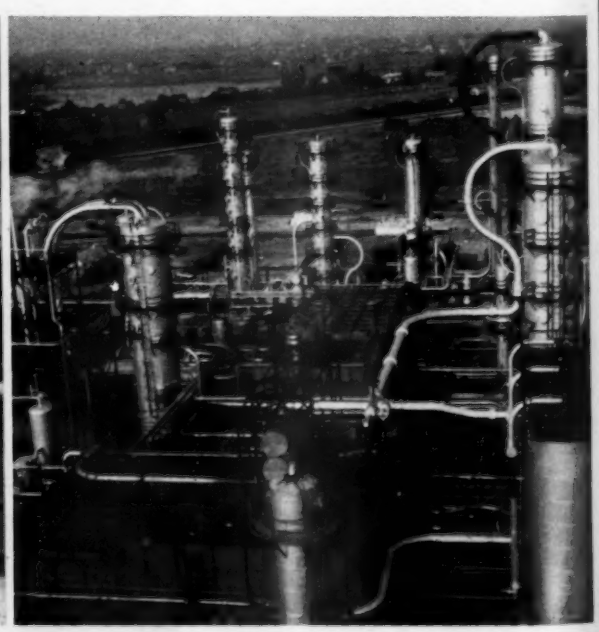
Utilities are procured from a boiler house with three oil-fired and two coal-fired boilers, a water pump house drawing cooling water from the River Elbe through two steam-turbine-driven pumps delivering to the cooling-water distribution system, and an electrical transformer substation. Electrical power is obtained from the Harmburg Electricity Works grid at 6,000 volts, being transformed to the low-tension current employed for power and lighting in the refinery.

The main products from the refinery consist of regular-grade motor gasoline, gas oil, fuel oil, and asphalt. Plans are under consideration for manufacturing a variety of grades of the last item.

Processing units. — The first proc-



Fractionating columns in the Eurotank plant at Hamburg.



Portion of processing section of rebuilt plant.

essing unit to be erected at the old refinery was a combined topping, cracking and reforming plant having an approximate throughput of 400,000 tons a year, and designed for processing Texas crude. It came on stream 15 years ago (in 1935) with a throughput of nearly 1,000 to 1,100 tons (7,000-8,000 bbl.) a day. In 1939 an atmospheric distillation unit was set up for the special purpose of providing close-specification products from a wide range of imported crudes. The refinery was closed down in 1940.

The tank farm was employed as a bulk storage depot until 1943. In that year the Hamburg area was subjected to very heavy bombing attacks by Allied air forces, and the Eurotank refinery, together with others in the neighborhood, was largely destroyed. After the war, efforts were made to clear the damaged portions of the site and were concentrated mainly on rehabilitating the topping unit.

When the refinery, or what remained of it, came under the ownership of Anglo-Iranian, a comprehensive scheme of rehabilitation was set into motion and work on the topping unit was expedited. The first postwar tanker load of crude to the Eurotank refinery was delivered early in February 1949 and the unit came on stream at a throughput of 450 tons (3,000 bbl.) a day later during the same month. Meanwhile, plans were completed for modernizing and rebuilding the combination unit, the gas-recovery plant, and the treating equipment.

Rebuilding program.—Orders were placed for the process and basic engineering design of the cracker to be carried out by the original designers of the plant in the United States, and for the detailed drafting to be executed by A. F. Craig in Britain. Modifications to the topping unit were decided upon with a view to stepping up capacity. Following the addition of some heat-exchange equipment, and other minor alterations to the furnace, the throughput of the plant was brought up to 750 tons (5,300 bbl.) a day in July 1949.

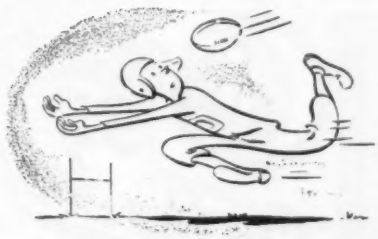
In other sectors of the site much work was done on the rehabilitation and reconstruction of the boiler house and other offsite facilities and services. Damaged tanks were cut down and rebuilt, and new roads and railways constructed. By March 1950 the new refinery began to take shape, the revamped tank farms and link-up lines were all completed, and work was focused on the extensions to the utilities distribution systems, the new laboratory and general office buildings, and housing for the refinery manager and senior members of the staff. The combination unit was brought on stream at full throughput on August 10, 1950, when the crude input amounted approximately to 1,200 tons (8,000 bbl.) a day.

Products distribution.—Since the Eurotank refinery was acquired by Anglo-Iranian close contact has been maintained with "Olex," the distributing agency for Anglo-Iranian in Germany. These two companies were recently merged for unifying control and operation of production and distribution.

Today the Eurotank refinery has full-scale facilities for the dispatch of products by ship, barge, or rail tank car. In view of the rigorous winter climate prevalent in this area it is vital that facilities should be available for dispatching products on a full production basis either by sea or by rail. To meet this imperative need the entire rail-siding system of the refinery was redesigned and laid out on the south side parallel to the Reichsbahn. Provision has also been made for the products dispatch system to be interlinked with that of the adjoining property purchased by Anglo-Iranian and on which facilities now exist for the loading of tank trucks for local distribution.

Barge Contract Let

A contract for the construction of a floating power barge for use in marine drilling operations in Venezuela has been awarded by the Shell organization to the British firm, Ferguson Brothers (Port Glasgow) Ltd.



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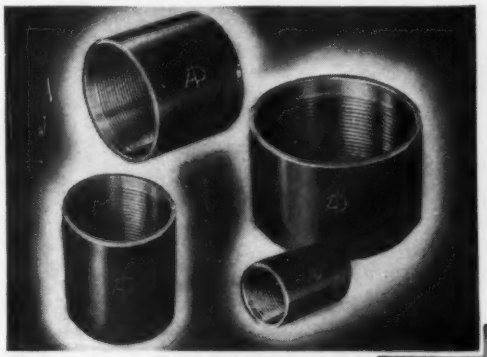

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World Supply-Demand

(Continued from page 203)

a net exporter to the Western Hemisphere.

For further evaluation of the shift in the international flow of oil, reference is made to Table 20.

Two important changes are to be noted:

1. A drastic shift in the primary sources of supply. During 1938 the Western Hemisphere supplied approximately 75 per cent and the Middle East 25 per cent of oil imports required by the countries of western Europe participating in the Marshall aid plan. By 1953 only a small fraction or 3 per cent of total oil import requirements will be required of Western Hemisphere origin whereas the Middle East is expected to supply the bulk or 97 per cent of total oil imports.

2. A reversal in the composition of oil imports. A reversal in the character of petroleum imports into the Marshall-plan countries of western Europe is evident when the year 1938 is compared with the expected import pattern for 1953. In 1938 refined products amounted to 60 per cent and crude oil 40 per cent of total petroleum imports; whereas in 1953 refined products are expected to decline to 10 per cent and crude oil rise to 90 per cent of total petroleum imports. This change in the character of imports reflects the large planned refinery expansion in the countries participating in the Marshall plan.

Conclusions

A study of the world outlook for petroleum supply and demand points up the following conclusions:

Related factors support the outlook for continued upward trend in demand for petroleum both in the United States and abroad during the next 3 years—a period of economic and military preparedness.

It is the belief of the petroleum industry that plans for increasing world producibility, expansion of refining and transportation facilities, all tend to indicate that sufficient supplies will be available generally to meet the expected larger demand for the next 3 years.

The problem confronting the industry regarding extraordinarily large quantities of special products needed by the military in the event of sudden all-out war will require constant planning and coordination.

United States oil companies may be forced to reduce their flow of oil to a number of countries abroad unless ways and means are found by them to accept and utilize foreign currencies instead of United States dollars.

An upward revision in the outlook for world oil demand is resolving or easing a number of old problems confronting the petroleum industry such as:

Threat of overexpansion of refining capacity in Europe.

Apprehension regarding overdevelopment of crude producibility in the Middle East.

Concern regarding loss of markets in Europe for crude and products produced in the Caribbean area.

The outlook for world availability of supplies related to world oil demand indicates a margin of about 10 per cent. A margin of safety of 10 per cent may not be adequate in view of the extensive economic and military preparedness program.

A tremendous task lies before the petroleum industry to provide the oil needed to implement the economic and military mobilization program for world security. A task involving many problems including a continuation of huge investments for further development of crude-oil production and for expansion of petroleum refining, transportation, and distribution facilities. However, the industry's commendable accomplishments achieved during past periods of emergency are assurances that this present task will also be fulfilled.

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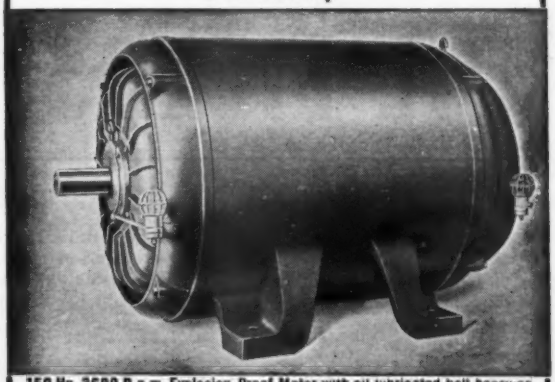

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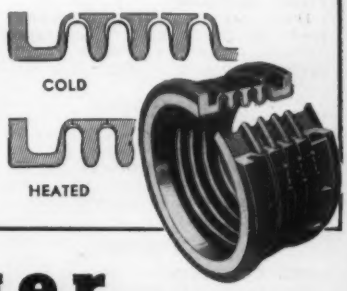

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THE JOURNAL'S WORLD-WIDE

SURVEY OF OIL FIELDS

Summary of World Oil Fields

Country (by areas)—	No. of producing wells	Accumulated production 7-1-50 (bbl.)	No. of wells drilling
Alaska	1	.....	1
Argentina†	1,252	171,804,003	3
Bolivia	27	5,175,820	5
Brazil	98	758,954	5
Canada	3,453	181,021,185	56
Chile	2	320,154	2
Colombia	1,210	485,674,397	18
Cuba*	....	.....	...
Ecuador	874	49,561,282	14
Mexico	1,164	2,427,800,729	47
Peru	3,251	393,808,025	14
Trinidad	1,821	371,122,055	21
Venezuela (Eastern)	2,350	1,178,489,298	38
Venezuela (Western)	5,991	4,425,645,914	62
Total W. Hemisphere (excl. U. S.)	21,474	9,691,181,816	286
Bahrein Island	66	116,289,883	2
Iran	82	3,122,000,000	8
Iraq	23	440,150,000	8
Kuwait	73	226,031,889	2
Qatar	11	5,903,000	2
Saudi Arabia	103	607,589,443	2
Turkey	4	46,000	3
Subtotal Middle East	362	4,518,010,215	27
Burma*	....	.....	...
China*	....	.....	...
East Indies	1,888	1,385,647,679	6
India	530	43,000,000	6
Japan*	....	.....	...
Pakistan*	....	.....	...
Subtotal Far East	2,418	1,428,647,679	12
Albania*	....	.....	...
Algeria	12	7,600	1
Austria*	....	.....	...
Czechoslovakia*	....	.....	...
Egypt	123	133,810,560	1
England (incl. Scotland)	242	4,434,980	...
France	669	21,179,325	18
French Morocco	41	554,400	2
Germany	1,948	94,007,981	63
Hungary*	....	.....	...
Italy	222	1,505,110	...
Netherlands	106	12,225,900	1
Poland*	....	.....	...
Romania*	....	.....	...
Yugoslavia*	....	.....	...
Total Europe and North Africa	3,363	278,725,856	86
Total E. Hemisphere (excl. U.S.S.R. satellites)	2,780	5,946,657,894	39
Grand total	27,617	15,915,565,566	411

*Reliable data unavailable. †Argentina totals are exclusive of government-owned Y.P.F. which does not report on its operations.

ALASKA

POINT BARROW—
Discovered: 1949; producing wells: 1 gas; producing depth: 2,505 ft.; estimated daily average production: 145,000 cu. ft.; producing formation: Jurassic.

ALBANIA

Definite information on the Albanian oil industry is not available. As in other U.S.S.R.-dominated countries, the oil industry is nationalized. The known oil-producing areas are Devoli, Berat, and Skodra Lake fields.

ALGERIA

QUED GUETERINI—
Discovered: 1949; producing wells: 2 flowing, 10 pumping; producing depth: 830 ft.; estimated daily average production: 75 bbl.; accumulative production to July 1, 1950: 7,600 bbl.; wells drilling: one; producing formation: Miocene; gravity: 35° A.P.I.

ARGENTINA*

AGUA BLANCA (Standard)—
Discovered: 1926; producing wells: three pumping; producing depth: 2,300-3,600 ft.; estimated daily average production: 55 bbl.; accumulative production to July 1, 1950: 1,337,945 bbl.; producing formation: Tarija, Permian; gravity: 23° A.P.I.

ASTRA ("Astra" Cia. Argentina de Petroleo, S.A.)—
Discovered: 1915; producing wells: 255 pumping; producing depth: 2,000-4,500 ft.; estimated daily average production: 3,500 bbl.; accumulative production to July 1, 1950: 26,933,770 bbl.; wells drilling: three; producing formation: Cretaceous sand; gravity: 25° A.P.I.

COMODORO RIVADAVIA-K27 (Shell)—
Discovered: 1925; producing wells: 364; producing depth: 3,400 ft.; estimated daily average production: 9,860 bbl.; accumulative production to July 1, 1950: 72,724,400 bbl.; wells drilling: two; producing formation: Upper Cretaceous; gravity: 24° A.P.I.

CERRO TARTAGAL (Standard)—
Discovered: 1927; producing wells: three pumping; producing depth: 2,300-3,600 ft.; estimated daily average production: 28 bbl.; accumulative production to July 1, 1950: 119,668 bbl.; producing formation: Tarija, Permian; gravity: 45° A.P.I.

DADIN (Standard)—
Discovered: 1924; producing wells: 5 flowing, 37 pumping; producing depth: 1,640-3,300 ft.; estimated daily average production: 275 bbl.; accumulative production to July 1, 1950: 8,216,721 bbl.; producing formation: Lotena, Jurassic; gravity: 36° A.P.I.

HUINCUL (Standard)—
Discovered: 1923; producing wells: 7 flowing, 36 pumping; producing depth: 2,600 ft.; estimated daily average production: 358 bbl.; accumulative production to July 1, 1950: 4,125,654 bbl.; producing formation: Lotena, Jurassic; gravity: 36° A.P.I

JOSE SEGUNDO (Ferrocarrilera de Petroleo)—
Discovered: 1922; producing wells: 15 pumping; producing depth: 2,307-3,576 ft.; estimated daily average production: 75 bbl.; accumulative production to July 1, 1950: 716,529 bbl.; producing formation: Cretaceous; gravity: 16° A.P.I.

KILOMETRO 8 (Ferrocarrilera de Petroleo)—
Discovered: 1915; producing wells: 227 pumping; producing depth: 1,677-1,713 ft.; estimated daily average production: 850 bbl.; accumulative production to July 1, 1950: 26,054,912 bbl.; producing formation: Cretaceous; gravity: 19° A.P.I.

LOMITAS (Standard)—
Discovered: 1927; producing wells: 35 pumping; producing depth: 700-3,300 ft.; estimated daily average production: 147 bbl.; accumulative production to July 1, 1950: 3,517,975 bbl.; producing formation: Tarija, Permian; gravity: 43° A.P.I.

MANANTIAL ROSALES (Ferrocarrilera de Petroleo)—
Discovered: 1922; producing wells: 114 pumping; producing depth: 1,975-3,025 ft.; estimated daily average production: 660 bbl.; accumulative production to July 1, 1950: 8,082,466 bbl.; producing formation: Cretaceous; gravity: 18° A.P.I.

RAMOS (Standard)—
Discovered: 1928; producing wells: two pumping; producing depth: 3,770-3,930 ft.; estimated daily average production: 18 bbl.; accumulative production to July 1, 1950: 81,171 bbl.; producing formation: Devonian; gravity: 54° A.P.I.

RESERVA (Ferrocarrilera de Petroleo)—
Discovered: 1922; producing wells: two pumping; producing depth: 1,749 ft.; estimated daily average production: 13 bbl.; accumulative production to July 1, 1950: 141,686 bbl.; producing formation: Cretaceous; gravity: 18° A.P.I.

SALAMANCA (Ferrocarrilera de Petroleo)—
Gas field. Producing depth: 1,431 ft.; producing formation: Cretaceous.

SAN PEDRO (Standard)—
Discovered: 1928; producing wells: 4 flowing, 21 pumping; producing depth: 1,800-3,300 ft.; estimated daily average production: 1,200 bbl.; accumulative production to July 1, 1950: 15,145,615 bbl.; producing formation: Tupambi, Permian; gravity: 31°-44° A.P.I.

SINDICATO (Ferrocarrilera de Petroleo)—
Discovered: 1928; producing wells: 38 pumping; producing depth: 2,966 ft.; estimated daily average production: 152 bbl.; accumulative production to July 1, 1950: 1,193,830 bbl.; producing formation: Cretaceous; gravity: 16° A.P.I.

SOLANO (Ferrocarrilera de Petroleo)—
Discovered: 1920; producing wells: 84 pumping; producing depth: 1,542-2,690 ft.; estimated daily average production: 380 bbl.; accumulative production to July 1, 1950: 3,329,585 bbl.; producing formation: Cretaceous; gravity: 22° A.P.I.

*Information covering 1950 operations of Yacimientos Petroliferos Fiscales (Y.P.F.), principal oil-producing company and owned by the government, is not available.

AUSTRIA*

ADERKLAA—
Discovered: 1942; producing depth: 8,000-8,500 ft.; producing formation: Miocene; gravity: 48° A.P.I.

GAISELBERG—
Discovered: 1938: producing depth: 2,700-3,800 ft.; producing formation: Miocene; gravity: 22°-27° A.P.I.

GOSTING—
Discovered: 1932; producing depth: 1,968 ft.; producing formation: Miocene; gravity: 20°-27° A.P.I.

HOHENRUPPERSDORF—
Discovered: 1941; producing depth: 3,300-5,400 ft.; producing formation: Miocene; gravity: 35° A.P.I.

LEOPRECHTING—
Discovered: 1942; producing depth: 400-500 ft.; producing formation: Miocene; gravity: 13° A.P.I.

MAUSTRENK—
Discovered: 1941; producing depth: 2,700-3,800 ft.; producing formation: Miocene; gravity: 26° A.P.I.

MUHLBERG—
Discovered: 1942; producing depth: 1,500-5,300 ft.; producing formation: Miocene; gravity 30° A.P.I.

MATZEN—
Discovered: 1948; producing depth: 5,000 ft.; producing formation: Miocene; gravity: 27°° A.P.I.

RAG—
Discovered: 1930; producing depth: 2,230 ft.; producing formation: Miocene; gravity: 20°-27° A.P.I.

R. K. van SICKLE—
Discovered: 1939; producing depth: 1,300-4,600 ft.; producing formation: Miocene; gravity: 21°-27° A.P.I.

ST. ULRICH-HAUSKIRCHEN—
Discovered: 1938; producing depth: 2,700-3,800 ft.; producing formation: Miocene; gravity: 31° A.P.I.

*Current oil production figures on this U.S.S.R. controlled country are not available.

BAHREIN ISLAND

Discovered: 1932; producing wells: 66 flowing; producing depth: 2,000-2,300 ft.; estimated daily average production: 30,000 bbl.; accumulative production to July 1, 1950: 116,289,883 bbl.; wells drilling: two; producing formation: Cretaceous limestone; gravity: 33.5° A.P.I.

BOLIVIA

BERMEJO—
Discovered: 1922; producing wells: one flowing, one pumping; producing depth: 3,000 ft.; estimated daily average production: 400 bbl.; accumulative production to July 1, 1950: 840,000 bbl.; wells drilling: one; producing formation: Permo-Triassic; gravity: 26° A.P.I.

CAMIRI—
Discovered: 1927; producing wells: 10 flowing, 6 pumping; producing depth: 3,190 ft.; estimated daily average production: 1,300 bbl.; accumulative production to July 1, 1950: 2,600,000 bbl.; wells drilling: three; producing formation: Devonian; gravity: 53° A.P.I.

GUAYRUY—
Discovered: 1947; producing wells: one flowing; producing depth: 2,200 ft.; estimated daily average production: 300 bbl.; accumulative production to July 1, 1950: 820 bbl.; wells drilling: one; producing formation: Devonian; gravity: 54° A.P.I.

SANADITA—
Discovered: 1926; producing wells: eight pumping; producing depth: 2,700 ft.; estimated daily average production: 400 bbl.; accumulative production to July 1, 1950: 1,735,000 bbl.; producing formation: Permo-Triassic; gravity: 42° A.P.I.

BRAZIL

ARATU—
Discovered: 1941; producing wells: three pumping; producing depth: 1,600 ft.; estimated daily average production: 10 bbl.; accumulative production to July 1, 1950: 56,561 bbl.; producing formation: Cretaceous; gravity: 43° A.P.I.

CANDEIAS—
Discovered: 1941: producing wells: 17 flowing, 45 pumping; producing depth: 2,500-4,000 ft.; estimated daily average production: 2,500 bbl.; accumulative production to July 1, 1950: 556,635 bbl.; wells drilling: three; producing formation: Cretaceous; gravity: 26°-30° A.P.I.

DOM JOAO—
Discovered: 1947; producing wells: 26 pumping; producing depth: 900-1,200 ft.; estimated daily average production: 25 bbl.; accumulative production to July 1, 1950: 17,165 bbl.; wells drilling: two; producing formation: Cretaceous; gravity: 37° A.P.I.

ITAPARICA—
Discovered: 1941; producing wells: three; producing depth: 1,800-2,500 ft.; estimated daily average production: 500 bbl.; accumulative production to July 1, 1950: 56,561 bbl.; producing formation: Cretaceous; gravity: 36° A.P.I.

LOBATO-JOANES—
Discovered: 1939; producing wells: four pumping; producing depth: 890-1,900 ft.; estimated daily average production: 30 bbl.; accumulative production to July 1, 1950: 72,032 bbl.; producing formation: Cretaceous; gravity: 30° A.P.I.

BURMA*

(Central Basin)

LANYA—
Discovered: 1919; producing depth: 2,000-5,000 ft.; producing formation: Oligocene sand; gravity: 36° A.P.I.

MINBU—
Producing depth: 450-700 ft.; producing formation: Miocene-Oligocene; gravity: 36° A.P.I.

PALANYOU—
Discovered: 1910; producing depth: 2,300 ft.; producing formation: Miocene-Oligocene; gravity: 36° A.P.I.

SABE—
Discovered: 1908; producing depth: 100-1,800 ft.; producing formation: Oligocene sand; gravity 36° A.P.I.

CHAUK—
Discovered: 1902; producing depth: 2,500-5,000 ft.; producing formation: Oligocene sand; gravity: 36° A.P.I.

YENAGYAUNG—
Discovered: 1889; producing depth: 350-5,000 ft.; producing formation: Miocene-Oligocene; gravity 36° A.P.I.

YENANGYAT—
Discovered: 1893; producing depth: 400-4,200 ft.; producing formation: Oligocene sand; gravity: 36° A.P.I.

YETHAYA—
Producing formation: Miocene-Oligocene; gravity: 36° A.P.I.

(North Basin)

INDAW—
Discovered: 1918; producing depth: 1,100 ft.; producing formation: Miocene sand; gravity: 36° A.P.I.

(South Basin)

PADAUKPIN—
Discovered: 1922.

PYAYE—
Discovered: 1928.

YENAMMA—
Discovered: 1922; producing depth: 600-1,700 ft.; producing formation: Oligocene sand; gravity: 36° A.P.I.

*Current total production in Burma is believed to be 1,800 bbl. per day from the Chauk field. Activity in Burma is held up due to unsettled political situation.

CANADA

BARRHEAD—
Discovered: 1949; producing wells: two; producing depth: 4,000 ft.; estimated daily average production: shut in; accumulative production to July 1, 1950: 4,133 bbl.; producing formation: Rundle limestone, Mississippian; gravity: 23° A.P.I.

BROOKS (BANTRY)—
Discovered: 1947; producing wells: two; producing depth: 3,250 ft.; estimated daily average production: 36 bbl.; accumulative production to July 1, 1950: 37,090 bbl.; producing formation: Lower Cretaceous; gravity: 24° °A.P.I.

CAMPBELL—
Discovered: 1949; producing wells: four; producing depth: 3,675 ft.; estimated daily average production: 105 bbl.; accumulative production to July 1, 1950: 23,761 bbl.; wells drilling: one; producing formation: Lower Cretaceous; gravity: 35° A.P.I.

CONRAD—
Discovered: 1944; producing wells: 32; producing depth: 3,200 ft.; estimated daily average production: 586 bbl.; accumulative production to July 1, 1950: 1,892,418 bbl.; producing formation: Ellis (Jurassic); gravity: 25° A.P.I.

DEL BONITA—
Discovered: 1943; producing wells: three; producing depth: 5,035 ft.; estimated daily average production: 11 bbl.; accumulative production to July 1, 1950: 55,144 bbl.; producing formation: Upper Mississippian; gravity: 38° A.P.I.

DINA—
Discovered: 1929; producing wells: three; producing depth: 1,800 ft.; estimated daily average production: 51 bbl.; accumulative production to July 1, 1950: 69,123 bbl.; producing formation: Lower Cretaceous.

EXCELSIOR—
Discovered: 1949; producing wells: 14; producing depth: 3,800 ft.; estimated daily average production: 334 bbl.; accumulative production to July 1, 1950: 62,214 bbl.; wells drilling: four; producing formation: Upper Devonian D2.

GOLDEN SPIKE—
Discovered: 1949; producing wells: four;; producing depth: 5,370 ft.; estimated daily average production: 746 bbl.; accumulative production to July 1, 1950: 135,166 bbl.; producing formation: Upper Devonian; gravity: 38°-39° A.P.I.

JOSEPH LAKE—
Discovered: 1949; producing wells: five; producing depth: 3,250 ft.; estimated daily average production: 250 bbl.; accumulative production to July 1, 1950: 81,133 bbl.; wells drilling: two; producing formation: Viking (Upper Cretaceous); gravity: 37° A.P.I.

LEDUC-WOODBEND—
Discovered: 1947-1948; producing wells: 426; producing depth: 4,200-5,300 ft.; estimated daily average production: 27,032 bbl.; accumulative production to July 1, 1950: 19,611,719 bbl.; wells drilling: 16; producing formation: Lower Cretaceous, Upper Devonian 2, Upper Devonian 3; gravity: 37°-40° A.P.I.

LLOYDMINSTER (Alberta)—
Discovered: 1939; producing wells: 139; producing depth: 1,920 ft.; estimated daily average production: 2,741 bbl.; accumulative production to July 1, 1950: 2,183,545 bbl.; producing formation: Lower Cretaceous; gravity: 14°-17°A.P.I.

LLOYDMINSTER (Saskatchewan)—
Discovered: 1939; producing wells: 186; producing depth: 1,920 ft.; estimated daily average production: 2,741 bbl.; accumulative production to July 1, 1950: 2,819,457 bbl.; producing formation: Lower Cretaceous; gravity: 14°-17° A.P.I.

NORMAN WELLS—
Discovered: 1920; producing wells: 60; producing depth: 1,050-1,900 ft.; estimated daily average production: 532 bbl.; accumulative production to July 1, 1950: 3,117,791 bbl.; producing formation: Fort Creek (Devonian); gravity: 39° A.P.I.

ONTARIO—
Discovered: 1859; producing wells: 1,600; producing depth: 500-3,000 ft.; estimated daily average production: 622 bbl.; accumulative production to July 1, 1950: 30,750,000 bbl.; wells drilling: 10; producing formation: Devonian, Ordovician, Silurian; gravity: 26°-39° A.P.I.

PINCHER CREEK—
Discovered: 1948; producing wells: two; producing depth: 11,755 ft.; accumulative production to July 1, 1950: 4,560 bbl.; wells drilling: one; producing formation: Upper Mississippian; gravity: 52° A.P.I.

PRINCESS—
Discovered: 1944-1945; producing wells: 27; producing depth: 3,200-4,000 ft.; estimated daily average production: 503 bbl.; accumulative production to July 1, 1950: 1,055,218 bbl.; producing formation: Mississippian, Upper Devonian; gravity: 27° A.P.I.

REDWATER—
Discovered: 1948; producing wells: 508; producing depth: 3,100 ft.; estimated daily average production: 21,738 bbl.; accumulative production to July 1, 1950: 8,765,096 bbl.; wells drilling: 21; producing formation: Devonian; gravity: 35° A.P.I.

STONY CREEK—
Discovered: 1910; producing depth: 1,000-3,200 ft.; estimated daily average production: 45 bbl.; accumulative production to July 1, 1950: 650,000 bbl.; producing formation: Albert (Mississippian); gravity: 37° A.P.I.

TABER (East, West)—
Discovered: 1942; producing wells: 28; producing depth: 3,200 ft.; estimated daily average production: 642 bbl.; accumulative production to July 1, 1950: 1,984,944 bbl.; producing formation: Lower Cretaceous; gravity: 18°-23° A.P.I.

TURNER VALLEY—
Discovered: 1914-1924; producing wells: 327; producing depth: 3,100-9,150 ft.; estimated daily average production: 952 bbl.; accumulative production to July 1, 1950: 104,098,770 bbl.; wells drilling: one; producing formation: Lower Cretaceous, Rundle (Mississippian); gravity: 43° A.P.I.

VERMILION—
Discovered: 1939; producing wells: 48; producing depth: 1,850 ft.; estimated daily average production: 147 bbl.; accumulative production to July 1, 1950: 1,204,461 bbl.; producing formation: Lower Cretaceous; gravity: 14°-15° A.P.I.

WAINWRIGHT—
Discovered: 1923; producing wells: eight; producing depth: 2,250 ft.; estimated daily average production: 39 bbl.; accumulative production to July 1, 1950: 297,652 bbl.; producing formation: Lower Cretaceous; gravity: 18° A.P.I.

OTHERS (Western)*
Producing wells: five; estimated daily average production: 105 bbl.; accumulative production to July 1, 1950: 3,117,791 bbl.

*Includes Armena, Bon Accord, Hanna, Normandville, Spring Coulee, and Volmer.

CHILE

CERRO SOMBRERO—
Discovered: 1950; producing wells: one flowing; producing depth: 7,500 ft.; estimated daily average production: 150 bbl.; accumulative production to July 1, 1950: shut in; producing formation: Springhill sand, Cretaceous; gravity: 38° A.P.I.

MANANTIALES—
Discovered: 1945; producing wells; 13 flowing; 4 pumping; producing depth: 7,500 ft.; estimated average daily production: 1,750 bbl.; accumulative production to July 1, 1950: 320,154 bbl.; wells drilling: two; producing formation: Springhill sand, Cretaceous; gravity: 43° A.P.I.

CHINA

LAOCHUNMIAO (Yumen)—
Discovered: 1939; producing depth: 1,400 ft;. producing formation: Miocene.

COLOMBIA

(Barco Concession)

CANTAGALLO—
Discovered: 1942; producing wells: three flowing; producing depth: 5,400-6,500 ft.; estimated daily average production: 1,200 bbl.; accumulative production to July 1, 1950: 1,112,491 bbl.; producing formation: La Paz, Eocene; gravity: 21.3° A.P.I.

CARBONERA—
Discovered: 1939; producing wells: two flowing; producing depth: 3,359 ft.; estimated daily average production: 1,000 bbl.; accumulative production to July 1, 1950: 95,097 bbl.; producing formation: Barco, Los Cuervos, Eocene; gravity: 21° A.P.I.

CASABE (Yondo)—
Discovered: 1939; producing wells: 12 flowing, 60 pumping; producing depth: 2,500-5,800 ft.; estimated daily average production: 27,000 bbl.; accumulative production to July 1, 1950: 25,563,932 bbl.; wells drilling: eight; producing formation: Colorado, Oligocene; gravity: 20.9° A.P.I.

DIFICIL—
Discovered: 1943; producing wells: 14 flowing; producing depth: 5,500-5,843 ft.; estimated daily average production: 3,200 bbl.; accumulative production to July 1, 1950: 2,691,884 bbl.; producing formation: El Dificil, Oligocene; gravity: 42.1° A.P.I.

PETROLEA—
Discovered: 1933; producing wells: 36 flowing, 1 pumping; producing depth: 99-1,953 ft.; estimated daily average production: 2,200 bbl.; accumulative production to July 1, 1950: 30,845,739 bbl.; producing formation: La Luna, Cogollo, Urib, Cretaceous; gravity: 46.2° A.P.I.

RIO DE ORO—
Discovered: 1937; producing wells: nine; producing depth: 1,865 ft.; estimated daily average production: shut in; accumulative production to July 1, 1950: 70,191 bbl.; producing formation: Catatumba, Urib, Juan, Cretaceous; gravity: 39° A.P.I.

SARDINTA—
Discovered: 1942; producing wells: one flowing; producing depth: 8,305 ft.; estimated average daily production: 200 bbl.; accumulative production to July 1, 1950: 287, bbl.; wells drilling: one; producing formation: Cretaceous; gravity: 54° A.P.I.

TETUAN (Texas Petroleum)—
Discovered: 1949; producing wells: two flowing; producing depth: 2,700 ft.; estimated daily average production: shut in; producing formation: Cretaceous lime; gravity: 23° A.P.I.

TIBU—
Discovered: 1940; producing wells: 60 flowing, 16 pumping; producing depth: 8,3950ft ; h8x2oSHRDLU CMFWYP ETA 3,580 ft.; estimated daily average production: 22,000 bbl.; accumulative production to July 1, 1950: 27,830,322 bbl.; wells drilling: six; producing formation: Barco, Catatumba, Cogollo, Urib, Eocene, Cretaceous; gravity: 32.5°-46.2° A.P.I.

VELASQUES (Teran)—
Discovered: 1946: producing wells: three flowing; producing depth: 6,700-8,455 ft.; estimated daily average production: 1,000 bbl.; accumulative production to July 1, 1950: 814,239 bbl.; producing formation: Guaduas, Eocene; gravity: 26.3° A.P.I.

De Mares Concession

COLORADO—
Discovered: 1930: producing wells: two flowing, three pumping; producing depth: 3,400-4,200 ft.; estimated daily average production: 250 bbl.; accumulative production to July 1, 1950: 376,471 bbl.; producing formation: Eocene; gravity: 38° A.P.I.

GALAN—
Discovered: 1945; producing wells: three pumping; producing depth: 3,900-4,050 ft.; estimated daily average production: 100 bbl.; accumulative production to July 1, 1950: 176,399 bbl.; producing formation: Oligocene; gravity: 19.5° A.P.I.

INFANTAS—
Discovered: 1915; producing wells: 3 flowing, 288 pumping; producing depth: 300-2,600 ft.; estimated daily average production: 9,000 bbl.; accumulative production to July 1, 1950: 154,574,048 bbl.; producing formation: Oligocene, Eocene; gravity: 26.4° A.P.I.

LA CIRA—
Discovered: 1926; producing wells: 2 flowing; 700 pumping; producing depth: 200-4,300 ft.; estimated daily average production: 23,000 bbl.; accumulative production to July 1, 1950: 241,523,297 bbl.; producing formation: Oligocene, Eocene; gravity: 24.3° A.P.I.

CUBA

JARAHUECA—
Discovered: 1943; producing depth: 1,500 ft.; estimated daily production: 190 bbl.; gravity: 37°-45° A.P.I.

MONTEMBO—
Discovered: 1880; producing depth: 600-

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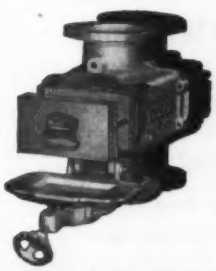

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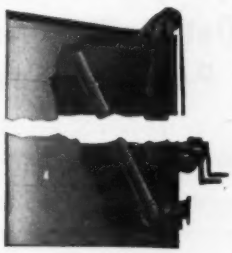

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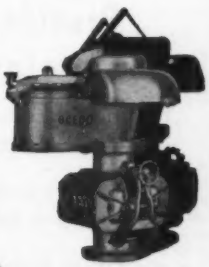

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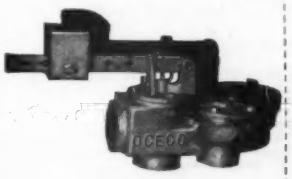

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Ingersoll Corporation — Shreveport, Louisiana, and Jackson, Mississippi.

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1,800 ft.; estimated daily average production: 55 bbl.; gravity 58°-61° A.P.I.

CZECHOSLOVAKIA*

GBLEY—
Discovered: 1913; producing depth: 550-800 ft.; producing formation: Miocene.

HODONIN—
Producing formation: Miocene.

*U.S.S.R. dominated, no current data available.

EAST INDIES

Borneo

ANGGANA-MUARA—
Discovered: 1902; producing wells: 3 flowing, 91 pumping; producing depth: 380-3,200 ft.; estimated daily average production: 3,900 bbl.; accumulative production to July 1, 1950: 62,599,200 bbl.; producing formation: Miocene; gravity: 19°-33° A.P.I.

BOENJUE—
Discovered: 1930; producing wells: shut in; producing depth: 1,970-3,100 ft.; accumulative production to July 1, 1950: 369,000 bbl.; wells drilling: two; producing formation: Pliocene; gravity: 24°-40° A.P.I.

SAMBODJA—
Discovered: 1910; producing wells: 1 flowing, 44 pumping; producing depth: 160-4,400 ft.; estimated daily average production:1,200 bbl.; accumulative production to July 1, 1950: 53,749,000 bbl.; producing formation: Miocene; gravity: 19°-33° A.P.I.

SANGA SANGA—
Discovered: 1897; producing wells: 86; producing depth: 430-2,900 ft.; estimated daily average production: 3,100 ft.; accumulative production to July 1, 1950: 145,229,-200 bbl.; wells drilling: one; producing formation: Miocene; gravity: 18°-36° A.P.I.

SANGATTA—
Discovered: 1940; producing wells: shut in; producing depth: 1,640-4,200 ft.; accumulative production to July 1, 1950: 710 bbl.; producing formation: Miocene; gravity: 36° A.P.I.

TANDJUNG—
Discovered: 1938; producing wells: shut in; producing depth: 2,500-4,300 ft.; accumulative production to July 1, 1950: 462,600 bbl.; wells drilling: one; producing formation: Eocene; gravity: 40° A.P.I.

TARAKAN—
Discovered: 1906; producing wells: 459; producing depth: 195-2,400 ft.; estimated daily average production: 7,600 bbl.; accumulative production to July 1, 1950: 162,-695,200 bbl.; producing formation: Pliocene; gravity: 20° A.P.I.

Brunei

SERIA-BRUNEI—
Discovered: 1929; producing wells: 34 pumping, 38 gas lift, 62 flowing; producing depth: 1,600-6,900 ft.; estimated daily average production: 80,000 bbl.; accumulative production to July 1, 1950: 120,825,780 bbl.; wells drilling: five; producing formation: Tertiary; gravity 19°-33° A.P.I.

Ceram

BOELA-LEMOEN—
Discovered: 1897; inactive; producing depth: 240-920 ft.; accumulative production to July 1, 1950: 8,203,000 bbl.; producing formation: Triassic, Pliocene; gravity: 23° A.P.I.

JAVA

KAWENGAN—
Discovered: 1926; producing wells: 35; producing depth: 1,750-2,700 ft.; estimated daily average production: 9,250 bbl.; accumulative production to July 1, 1950: 40,094,700 bbl.; producing formation: Miocene; gravity: 34° A.P.I.

KRUKA—
Discovered: 1929; producing wells: 61; producing depth: 970-1,600 ft.; estimated daily average production: 1,400 bbl.; accumulative production to July 1, 1950: 7,654,600 bbl.; production formation: Miocene; gravity: 30° A.P.I.

LEDOK—
Discovered: 1896; inactive; producing depth: 320-3,200 ft.; accumulative production to July 1, 1950: 21,125,000 bbl.; producing formation: Miocene; gravity: 43° A.P.I.

LINDA-KOELON—
Discovered: 1896; inactive; producing depth: 490-1,330 ft.; accumulative production to July 1, 1950: 33,369,000 bbl.; producing formation: Miocene; gravity: 24° A.P.I.

LOESI—
Discovered: 1932; inactive; producing depth: average 2,300 ft.; producing formation; Tertiary; gravity: 40° A.P.I.

NGLIRON—
Discovered: 1940; inactive; producing depth: average 6,000 ft.; producing formation: Tertiary; gravity: 40° A.P.I.

NGLOBO-SEMANGGI-BANJOEASIN—
Discovered: 1897; inactive; producing depth: 370-3,550 ft.; accumulative production to July 1, 1950: 18,044,000 bbl.; producing formation: Miocene; gravity: 43° A.P.I.

PETAK—
Discovered: 1914; inactive; producing depth: average 2,300 ft.; producing formation: Tertiary; gravity: 40° A.P.I.

TREMBOEL—
Discovered: 1917; inactive; producing detpth: average 2,300 ft.; producing formation: Tertiary; gravity: 40° A.P.I.

New Guinea*

KIAMONA—
Discovered: 1936; producing wells: 10; producing depth: 300-650 ft.; estimated daily average production: 5,000 bbl.; accumulative production to July 1, 1950: 2,750,000 bbl.; producing formation: Miocene lime; gravity: 19° A.P.I.

MOGOI—
Discovered: 1940: producing wells: shut in; producing depth: 1,250 ft.; accumulative production to July 1, 1950: 500 bbl.; producing formation: Miocene; gravity: 46° A.P.I.

WASIAN—
Discovered: 1940; producing wells: shut in; producing depth: 2,900-3,225 ft.; accumulative production to July 1, 1950: 1,000 bbl.; producing formation: Miocene; gravity: 48° A.P.I.

*Estimated.

Sarawak

MIRI—
Discovered: 1911; producing wells: 119; producing depth: 300-3,050 ft.; estimated daily average production: 1,100 bbl.; accumulative production to July 1, 1950: 71,464,-539 bbl.; producing formation: Tertiary; gravity: 21°-35° A.P.I.

Sumatra

(Northern District)

Dj. RAJEU—
Discovered: 1929; producing depth: 2,500-2,600 ft.; accumulative production to July 1, 1950: 559,000 bbls.; producing formation: Pliocene; gravity: 54° A.P.I.

GEBANG—
Discovered: 1936; producing depth: 2,970-3,480 ft.; accumulative production to July 1, 1950: 135,000 bbl.; producing formation: Miocene; gravity: 54° A.P.I.

P. TABUHAN—
Discovered: 1937: producing depth: 3,300-3,500 ft.; accumulative production to July 1, 1950: 3,238,000 bbl.; producing formation: Miocene; gravity: 52° A.P.I.

PANGKALAN SUSU—
Discovered: 1917; producing depth: 1,550-2,100 ft.; accumulative production to July 1, 1950: 6,287,000 bbl.; producing formation: Miocene; gravity: 56° A.P.I.

PASE—
Discovered: 1939; producing depth: average 2,000 ft.; accumulative production to July 1, 1950: 52,000 bbl.; producing formation: Tertiary; gravity: 23°-30° A.P.I.

PERLAK—
Discovered: 1900; producing depth: 160-2,200 ft.; accumulative production to July 1, 1950: 47,870,000 bbl.; producing formation: Miocene; gravity: 57° A.P.I.

PULU PANDJANG—
Discovered: 1928; producing depth: 1,640-2,400 ft.; accumulative production to July 1, 1950: 11,243,000 bbl.; producing formation: Miocene; gravity: 55° A.P.I.

RANTAU—
Discovered: 1929: producing depth: 1,040-2,560 ft.; accumulative production to July 1, 1950: 55,513,000 bbl.; producing formation: Miocene; gravity: 48° A.P.I.

SERANG DJAJA—
Discovered: 1926; producing depth: 3,560-4,150 ft.; accumulative production to July 1, 1950: 7,551,000 bbl.; producing formation: Miocene; gravity: 64° A.P.I.

TELAGA SAID-DARAT-K. GADJAH—
Discovered: 1893; producing depth: 210-720 ft.; accumulative production to July 1, 1950: 23,621,000 bbl.; producing formation: Miocene; gravity: 51° A.P.I.

(Central District)

DOERI—
Discovered: 1941; producing depth: 475 ft.; production formation: Mioene; gravity: 15° A.P.I.

LIRIK-UKUL—
Discovered: 1941; producing depth: average 1,800 ft.; producing formation: Tertiary; gravity: 34° A.P.I.

MINAS—
Discovered: 1942; producing wells: shut in; producing depth: 2,500 ft.; drilling wells: one; producing formation: Miocene, gravity: 15° A.P.I.

SEBANGA—
Discovered: 1940; inactive; producing depth: 1,206 ft.; producing formation: Miocene; gravity: 30° A.P.I.

(Southern District)

BENAKAT—
Discovered: 1933; producing wells: 118; producing depth: average 1,600 ft.; estimated daily average production: 10,000 bbl.; accumulative production to July 1, 1950: 44,620,000 bbl.; wells drilling: one; producing formation: Tertiary; gravity: 38° A.P.I.

DJIRAK—
Discovered: 1930; producing wells: 124 flowing; producing depth: average 1,000 ft.; estimated daily average production: 7,700 bbl.; accumulative production to July 1, 1950: 26,388,000 bbl.; wells drilling: one; producing formation: Tertiary; gravity: 38° A.P.I.

RADJA—
Discovered: 1941; producing wells: 13 flowing; producing depth: average 7,000 ft.; estimated daily average production: 3,800 bbl.; accumulative production to July 1, 1950: 523,000 bbl.; wells drilling: three; producing formation: Tertiary; gravity: 40° A.P.I.

SELO—
Discovered: 1938; producing depth: average 2,200 ft.; estimated daily production: shut in; accumulative production to July 1, 1950: 47,000 bbl.; producing formation: Tertiary; gravity: 38° A.P.I.

TALANG-AKAR-PENDOPA—
Discovered 1922; producing wells 302; producing depth: average 2,800 ft.; estimated daily average production: 43,000 bbl.; accumulative production to July 1, 1950: 152,961,-000 bbl.; wells drilling: one; producing formation: Tertiary; gravity: 38° A.P.I.

Djambi Area

BADJUBANG—
Discovered: 1927; producing wells: 28; producing depth: 2,700-3,100 ft.; estimated daily average production: 4,500 bbl.; accumuative production to July 1, 1950: 26,285,-900 bbl.; producing formation: Miocene; gravity: 46° A.P.I.

BETUNG—
Discovered: 1923; producing depth: 2,700-3,100 ft.; accumulative production to July 1, 1950: 2,100,000 bbl.; producing formation: Miocene; gravity: 40° A.P.I.

KENALI ASAM—
Discovered: 1931; producing wells: 41

flowing; producing depth: 1,700-4,100 ft.; estimated daily average production: 7,700 bbl.; accumulative production to July 1, 1950: 22,805,800 bbl.; producing formation: Miocene; gravity: 22°-46° A.P.I.

MERUO SENAMI—
Discovered: 1938; test field not producing; producing depth: 2,400-2,650 ft.; accumulative production to July 1, 1950: 95,700 bbl.; producing formation: Miocene; gravity: 48° A.P.I.

TEMPINO—
Discovered: 1931; producing wells: 39; producing depth: 1,930-2,700 ft.; estimated daily average production: 6300 bbl.; accumulative production to July 1, 1950: 39,513,000 bbl.; producing formation: Miocene; gravity: 48° A.P.I.

BABAT—
Discovered: 1901; producing wells: 22; producing depth: 100-1,050 ft.; estimated daily average production: 90 bbl.; accumulative production to July 1, 1950: 8,136,000 bbl.; producing formation: Miocene; gravity: 38° A.P.I.

KARANG RINGIN—
Discovered: 1903; producing depth: 160-1,200 ft.; accumulative production to July 1, 1950: 1,572,000 bbl.; producing formation: Pliocene, Miocene; gravity: 42° A.P.I.

KLUANG—
Discovered: 1914; producing depth: 2,300-2,600 ft.; accumulative production to July 1, 1950: 27,882,000 bbl.; producing formation: Miocene; gravity: 40° A.P.I.

LIMAU—
Discovered: 1928; producing wells: 8; producing depth: 5,200-5,400 ft.; estimated daily average production: 1,500 bbl.; accumulative production to July 1, 1950: 6,782-300 bbl.; wells drilling: one; producing formation: Miocene; gravity: 25° A.P.I.

MANGUNDJAJA—
Discovered 1935; producing wells: 51; producing depth: 660-2,200 ft.; estimated daily average production: 2,500 bbl; accumulative production to July 1, 1950: 10,548,-950 bbl.; producing formation: Pliocene; gravity: 24° A.P.I.

MOEARA-ENIM—
Discovered: 1903; producing wells: 16; producing depth: 300-1,150 ft.; estimated daily average production: 230 bbl.; accumulative production to July 1, 1950: 28,206,-500 bbl.; producing formation: Pliocene, Miocene; gravity 46° A.P.I.

SUBAN DJERIGI—
Discovered: 1905; producing wells: 27; producing depth: 1,300-2,500 ft.; estimated daily average production: 750 bbl.; accumulative production to July 1, 1950: 34,103,-900 bbl.; producing formation: Pliocene, Miocene; gravity: 46° A.P.I.

TALANG DJIMAR—
Discovered: 1937; producing wells: 40; producing depth: 3,600-4,200 ft.; estimated daily average production: 17,300 bbl.; accumulative production to July 1, 1950: 43,309,-800 bbl.; wells drilling: one; producing formation: Miocene; gravity: 28° A.P.I.

TANDJOENG TIGA—
Discovered: 1940; producing wells: 16 flowing; producing depth: 2,200-2,800 ft.; estimated daily average production: 6,000 bbl.; accumulative production to July 1, 1950: 988,200 bbl.; wells drilling: two; producing formation: Miocene; gravity: 25° A.P.I.

T. LUNTAR—
Discovered: 1912; producing depth: 2,200-2,800 ft.; accumulative production to July 1, 1950: 4,072,000 bbl.; producing formation: Pliocene; gravity: 56° A.P.I.

ECUADOR

ANCON—
Discovered: 1921; producing wells: 60 flowing, 680 pumping; producing depth: 500-5,500 ft.; estimated daily average production: 5,400 bbl.; accumulative production to July 1, 1950: 41,070,230 bbl.; wells drilling: eight; producing formation: Eocene; gravity: 40° A.P.I.

CAROLINA-STA. PAULA—
Discovered: 1923; producing wells: 25 flowing; producing depth: 500-1,300 ft.; estimated daily average production: 130 bbl.; accumulative production to July 1, 1950: 1,200,000 bbl.; wells drilling: one; producing formation: Eocene; gravity: 39° A.P.I.

CAUTIVO-TIGRE—
Discovered: 1920; producing wells: 60 flowing; producing depth: 400-6,000 ft.; estimated daily average production: 1,200 bbl.; accumulative production to July 1, 1950: 5,500,000 bbl.; wells drilling: three; producing formation: Eocene; gravity: 38° A.P.I.

CONCEPTION—
Discovered: 1931; producing wells: 29 flowing; producing depth: 1,100-3,600 ft.; estimated daily average production: 136 bbl.; accumulative production to July 1, 1950: 918,824 bbl.; wells drilling: one; producing formation: Eocene; gravity: 39° A.P.I.

PETROPOLIS—
Discovered: 1937; producing wells: 20 flowing; producing depth: 1,400-4,000 ft.; estimated daily average production: 230 bbl.; accumulative production to July 1, 1950: 872,228 bbl.; wells drilling: one; producing formation: Eocene; gravity: 39° A.P.I.

EGYPT

ASL—
Discovered: 1948; producing wells: 7 flowing; producing depth: 2,870-3,870 ft.; estimated daily average production: 3,400 bbl.; accumulative production to July 1, 1950: 2,919,630 bbl.; producing formation: Eocene; gravity: 22° A.P.I.

GEMSA—
Discovered: 1908; producing wells: shut in; producing depth: 400-2,000 ft.; accumulative production to July 1, 1950: 1,420,000 bbl.; producing formation: Miocene; gravity: 23° A.P.I.

HURGHADA—
Discovered: 1913; producing wells: 20 pumping; producing depth: 700-2,500 ft.; estimated daily average production: 750 bbl.; accumulative production to July 1, 1950: 37,871,703 bbl.; producing formation: Miocene, Cretaceous; gravity: 23° A.P.I.

RAS GHARIB
Discovered: 1938; producing wells: 16 flowing, 71 pumping; producing depth: 1,200-2,500 ft.; estimated daily average production: 22,400 bbl.; accumulative production to July 1, 1950: 90,876,313 bbl.; wells drilling: one; producing formation: Miocene, Cretaceous; gravity: 26° A.P.I.

RAS MATAMA—
Discovered: 1948; producing wells: shut in; producing depth: 1,940-3,200 ft.; producing formation: Miocene; gravity: 19° A.P.I.

SURD—
Discovered: 1948; producing wells: eight flowing, one pumping; producing depth: 2,500-3,100 ft.; estimated daily average production: 14,700; accumulative production to July 1, 1950: 11,722,914 bbl.; producing formation: Eocene lime; gravity: 23° A.P.I.

ENGLAND-SCOTLAND

FORMBY—
Discovered: 1939; producing wells: eight; producing depth: 85-130 ft.; estimated daily average production: 6 bbl.; accumulative production to July 1, 1950: 62,150 bbl.; producing formation: Upper Millstone; gravity: 35° A.P.I.

EAKRING—
Discovered: 1939; producing wells: 55; producing depth: 1,800-2,500 ft.; estimated daily average production: 350 bbl.; accumulative production to July 1, 1950: 1,131,800 bbl.; producing formation: Upper Millstone; gravity: 33° A.P.I.

DUKES WOOD—
Discovered: 1941; producing wells: 114; producing depth: 1,800-2,500 ft.; estimated daily average production: 425 bbl.; accumulative production to July 1, 1950: 2,110,-700 bbl.; producing formation: Upper Millstone; gravity: 33° A.P.I.

KEIHAM HILLS—
Discovered: 1941; producing wells: 53; producing depth: 2,000-2,200 ft.; estimated daily average production: 155 bbl.; accumulative production to July 1, 1950: 942,150 bbl.; producing formation: Upper Millstone; gravity: 28° A.P.I.

CAUNTON—
Discovered: 1943; producing wells: 10; producing depth: 2,000-2,200 ft.; estimated daily average production: 30 bbl.; accumulative production to July 1, 1950: 168,700 bbl.; producing formation: Upper Millstone; gravity: 28° A.P.I.

MIDLOTHIAN—
Discovered: 1938; producing wells: two; producing depth: 1,750 ft.; estimated daily average production: 3 bbl.; accumulative production to July 1, 1950: 19,480 bbl.; producing formation: Carb.-Dalkeith; gravity: 40° A.P.I.

FRANCE

LACQ—
Discovered: 1950; producing wells: two flowing, one pumping; producing depth: 2,130 ft.; estimated daily average production: 1,600 bbl.; accumulative production to July 1, 1950: 137,000 bbl.; wells drilling: three; producing formation: Cretaceous; gravity: 22° A.P.I.

PECHELBRONN—
Discovered: 1813-1950; producing wells: 4 flowing, 650 producing; producing depth: 650-3,000 ft.; estimated daily average production: 1,375 bbl.; accumulative production to July 1, 1950: 21,000,000 bbl.; wells drilling: 15; producing formation: Oligocene, Jurassic, Triassic; gravity: 32° A.P.I.

ST. MARCET—
Discovered: 1939; producing wells: two; producing depth: 5,000 ft.; estimated daily average production: 15 bbl.; accumulative production to July 1, 1950: 42,325 bbl.; producing formation: Jurassic, Cretaceous; gravity: 30° A.P.I.

French Morocco

AIN HAMRA—
Discovered: 1918; producing wells: 17 pumping; producing depth: 500 ft.; estimated daily average production: 17 bbl.; accumulative production to July 1, 1950: 63,500 bbl.; producing formation: Tortonian; gravity: 41° A.P.I.

OUED BETH—
Discovered: 1947; producing wells: 23 flowing; producing depth: 3,150-2,000 ft.; estimated daily average production: 825 bbl.; accumulative production to July 1, 1950: 353,500 bbl.; wells drilling: two; producing formation: Primarie; gravity: 34° A.P.I.

TSELFAT—
Discovered: 1934; producing wells: one pumping; producing depth: 830 ft.; estimated daily average production: 14 bbl.; accumulative production to July 1, 1950: 137,400 bbl.; producing formation: Toarcian; gravity: 45° A.P.I.

GERMANY

FORST-WEIHER—
Discovered: 1934; producing wells: 50 pumping; producing depth: 1,000-2,500 ft.; estimated daily average production: 50 bbl.; accumulative production to July 1, 1950: 540,000 bbl.; wells drilling: one; producing formation: Upper Eocene, Keuper, Dogger ss.; gravity: 33° A.P.I.

WEINGARTEN—
Discovered: 1936; producing wells: 76 pumping; producing depth: 800-1,600 ft.; estimated daily average production: 70 bbl.; accumulative production to July 1, 1950: 278,369 bbl.; wells drilling: one; producing formation: Tertiary, Oligocene; gravity: 34° A.P.I.

Emsland District

ADORF—
Discovered: 1946; producing wells: one pumping; producing depth: 4,000-4,400 ft.; estimated daily average production: 20 bbl.; accumulative production to July 1, 1950: 34,622 bbl.; producing formation: Wealden,

Lower Cretaceous, shell beds; gravity: 30° A.P.I.

EMLICHHEIM—
Discovered: 1943; producing wells: 67 pumping; producing depth: 2,400-2,900 ft.; estimated daily average production: 2,800 bbl.; accumulative production to July 1, 1950: 2,511,837 bbl.; wells drilling: two; producing formation: Valendis, Lower Cretaceous sand; gravity: 25° A.P.I.

GEORGSDORF—
Discovered: 1944; producing wells: 108 flowing, 7 pumping; producing depth: 1,600-3,300 ft.; estimated daily average production: 4,700 bbl.; accumulatie production to July 1, 1950: 2,445,209 bbl.; wells drilling: 11; producing formation: Valendis, Lower Cretaceous sand; gravity: 24° A.P.I.

LINGEN-DALUM—
Discovered: 1942; producing wells: 2 flowing, 88 pumping; producing depth: 2,600-3,800 ft.; estimated daily average production: 1,250 bbl.; accumulative production to July 1, 1950: 1,838,280 bbl.; wells drilling: six; producing formation: Valendis, Wealden, Apt, Serpulite, Lower Cretaceous, ss., lime, and marl; gravity: 30°-32° A.P.I.

RUEHLERMOOR—
Discovered: 1949; producing wells: seven flowing, two pumping; producing depth: 1,930-2,650 ft.; estimated daily average production: 475 bbl.; accumulative production to July 1, 1950: 58,282 bbl.; wells drilling: three; producing formation: Valendis, Lower Cretaceous sand; gravity: 25° A.P.I.

RUEHLERTWIST—
Discovered: 1949; producing wells: six pumping; producing depth: 2,380-2,890 ft.; estimated daily average production: 350 bbl.; accumulative production to July 1, 1950: 4,571 bbl.; wells drilling: two; producing formation: Valendis, Lower Cretaceous ss.; gravity: 25° A.P.I.

SCHEERHORN—
Discovered: 1949; producing wells: three flowing, one pumping; producing depth: 3,630-3,700 ft.; estimated daily average production: 200 bbl.; accumulative production to July 1, 1950: 36,435 bbl.; wells drilling: three; producing formation: Valendis, Lower Cretaceous ss.; gravity: 30° A.P.I.

Hamburg District

REITBROOK—
Discovered: 1937; producing wells: 55 flowing, 64 pumping; producing depth: 1,400-2,600 ft.; estimated daily average production: 820 bbl.; accumulative production to July 1, 1950: 8,300,982 bbl.; wells drilling: one; producing formation: Lower Eocene ss., Reitbrook beds, Upper Cretaceous ls., Cretaceous; gravity: 21°-23° A.P.I.

Hanover District

BROISTEDT—
Discovered: 1937; producing wells: 10 pumping; producing depth: 2,400-3,200 ft.; estimated daily average production: 115 bbl.; accumulative production to July 1, 1950: 245,601 bbl.; wells drilling: one; producing formation: Valendis, Lower Cretaceous; gravity: 33° A.P.I.

CALBERLAH—
Discovered: 1945; producing wells: eight pumping; producing depth: 160-400 ft.; estimated daily average production: 20 bbl.; accumulative production to July 1, 1950: 25,619 bbl.; producing formation: Dogger, Jurassic sand; gravity: 19°-22° A.P.I.

EDDESSE-OELHEIM—
Discovered: 1876; producing wells: 20 pumping; producing depth: 2,800-3,300 ft.; estimated daily average production: 45 bbl.; accumulative production to July 1, 1950: 1,649,278 bbl.; producing formation: Rhaetic, Triassic sand; gravity: 32° A.P.I.

EHRA—
Discovered: 1939; producing wells: 12 pumping; producing depth: 500-820 ft.; estimated daily average production: 11 bbl.; accumulative production to July 1, 1950: 70,322 bbl.; producing formation: L. Dogger, Jurassic sand; gravity: 17° A.P.I.

EICKLINGEN-WIENHAUSEN—
Discovered: 1937; producing wells: 13 pumping; producing depth: 1,650-3,100 ft.; estimated daily average production: 210 bbl.; accumulative production to July 1, 1950: 1,722,832 bbl.; producing formation: Valendis, Wealden, Cretaceous sand; gravity: 32°-33° A.P.I.

EILTE—
Discovered: 1947; producing wells: one pumping; producing depth: 3,560-3,700 ft.; estimated daily average production: 5 bbl.; accumulative production to July 1, 1950: 6,789 bbl.; wells drilling: one; producing formation: Lower Cretaceous; gravity: 24.7° A.P.I.

ELDINGEN—
Discovered: 1949; producing wells; three flowing; producing depth: 5,220 ft.; estimated daily average production: 150 bbl.; accumulative production to July 1, 1950: 8,510 bbl.; wells drilling: two; producing formation: Angulaten ss., Liassic; gravity: 34° A.P.I.

ETZEL—
Discovered: 1942; producing wells: two pumping; producing depth: 4,550-4,700 ft.; estimated daily average production: 95 bbl.; accumulative production to July 1, 1950: 183,889 bbl.; producing formation: cap rock, Jurassic lime; gravity: 13° A.P.I.

FUHRBERG-HAMBUEHREN—
Discovered: 1939; producing wells: 193 pumping; producing depth: 260-2,100 ft.; estimated daily average production: 1,000 bbl.; accumulative production to July 1, 1950: 3,183,914 bbl.; wells drilling: five; producing formation: Dogger ss., Jurassic; gravity: 24° A.P.I.

GIFHORN—
Discovered: 1935; producing wells: 38 pumping; producing depth: 660-820 ft.; estimated daily average production: 35 bbl.; accumulative production to July 1, 1950: 281,400 bbl.; producing formation: Wealden, L. Cretaceous sand; gravity: 17° A.P.I.

HADEMSTORF—
Discovered: 1941; producing wells: 13 pumping; producing depth: 3,970-4,480 ft.; estimated daily average production: 239 bbl.; accumulative production to July 1, 1950: 441,581 bbl.; producing formation: Wealden, Lower Cretaceous; gravity: 26° A.P.I.

HOHENASSEL—
Discovered: 1943; producing wells: 29 pumping; producing depth: 1,250-2,100 ft.; estimated daily average production: 320 bbl.; accumulative production to July 1, 1950: 1,175,255 bbl.; wells drilling: one; producing formation: coral oolite, Jurassic lime; gravity: 30° A.P.I.

MECKELFELD—
Discovered: 1938; producing wells: 22 pumping; producing depth: 1,000-1,670 ft.; estimated daily average production: 55 bbl.; accumulative production to July 1, 1950: 349,086 bbl.; producing formation: Cretaceous; gravity: 24° A.P.I.

MOELME—
Discovered: 1935; producing wells: 37 pumping; producing depth: 160-1,800 ft.; estimated daily average production: 80 bbl.; accumulative production to July 1, 1950: 1,010,451 bbl.; producing formation: Wealden ss., Cretaceous, coral oolite, Rhaetic; gravity: 32° A.P.I.

NIENHAGEN-HAENIGSEN—
Discovered: 1899; producing wells: 5 flowing, 246 pumping; producing depth: 600-5,350 ft.; estimated daily average production: 2,140 bbl.; accumulative production to July 1, 1950: 32,482,017 bbl.; wells drilling: three; producing formation: Valendis, Wealden, Cretaceous ss., Cornbrash, Jurassic ls.-ss.; gravity: 22°-40° A.P.I.

OBERG—
Discovered: 1919; producing wells: 49 pumping; producing depth: 500-1,900 ft.; estimated daily average production: 179 bbl.; accumulative production to July 1, 1950: 2,005,414 bbl.; wells drilling: one; producing formation: Wealden, Cretaceous, L. Dogger, Jurassic; gravity: 37.1° A.P.I.

QUAKENBRUECK—
Discovered: 1950; producing wells: six flowing; producing depth: 1,830-1,940 ft.; estimated daily average production: 250 bbl.; accumulative production to July 1, 1950: 29,099 bbl.; wells drilling: three; producing formation: Wealden, Cretaceous; gravity: 39° A.P.I.

STEIMBKE—
Discovered: 1943; producing wells: 213 pumping; producing depth: 660-2,460 ft.; estimated daily average production: 1,450 bbl.; accumulative production to July 1, 1950: 3,389,113 bbl.; wells drilling: two; producing formation: Serpulite, Cornbrash ls. and ss., Jurassic; gravity 19° A.P.I.

SUDERBRUCH—
Discovered: 1949; producing wells: three flowing; producing depth: 6,750-6,790 ft.; estimated daily average production: 700 bbl.; accumulative production to July 1, 1950: 114,510 bbl.; wells drilling: three; producing formation: Cornbrash, Jurassic; gravity: 35.2° A.P.I.

THOEREN—
Discovered: 1941; producing wells: 58 pumping; producing depth: 1,550-4,000 ft.; estimated daily average production: 280 bbl.; accumulative production to July 1, 1950: 1,082,312 bbl.; wells drilling: one; producing formation: Wealden, Cretaceous, Cornbrash, Rhaetic, Triassic; gravity: 18°-35° A.P.I.

WESENDORF—
Discovered: 1943; producing wells: 24 flowing, 13 pumping; producing depth: 2,600-6,000 ft.; estimated daily average production: 1,386 bbl.; accumulative production to July 1, 1950: 2,696,351 bbl.; wells drilling six; producing formation: Neocomian, L. Dogger, Liassic ss.; gravity: 17°-40° A.P.I.

WIETSE—
Discovered: 1874; producing wells: 342 pumping; producing depth: 300-1,080 ft.; estimated daily average production: 532 bbl.; accumulative production to July 1, 1950: 16,718,210 bbl.; producing formation: Senonian, Wealden, Cornbrash, Rhaetic, Cretaceous, Jurassic; gravity: 18°-27° A.P.I.

Schleswig District

HEIDE—
Discovered: 1935; producing wells: 1 flowing, 50 pumping; producing depth: 2,500-4,500 ft.; estimated daily average production: 1,250 bbl.; accumulative production to July 1, 1950: 9,087,841 bbl.; wells drilling: four; producing formation: Lower Cretaceous, basal Breccia, Zechstein ls.; gravity: 18°-32° A.P.I.

HUNGARY*

BUDAFAPUSTZA—
Discovered: 1937; producing depth: 3,500-3,900 ft.; producing formation: Pliocene; gravity: 38° A.P.I.

BUKKSZEK—
Discovered: 1937; producing depth: 250-4,500 ft.; producing formation: Oligocene.

HAHOT—
Discovered: 1942; producing depth: 4,675-4,900 ft.; producing formation: Pliocene; gravity: 30° A.P.I.

LOVASZI—
Discovered: 1940; producing depth: 3,950-4,900 ft.; producing formation: Pliocene; gravity: 43° A.P.I.

UJFALU—
Discovered: 1941; producing depth: 2,000 ft.; producing formation: Pliocene; gravity: 40° A.P.I.

*U.S.S.R. dominated country, no current production data available.

INDIA

DIGBOI—
Discovered: 1890; producing wells: 310 flowing, 220 pumping; producing depth: 500-5,000 ft.; estimated daily average production: 5,000 bbl.; accumulative production to July 1, 1950: 43,000,000 bbl.; wells drilling: six; producing formation: Tipam ss., Miocene; gravity: 36° A.P.I.

IRAN

AGHA JARI—
Discovered: 1937-38; producing wells: 15 flowing; producing depth: 6,000-9,000 ft.; estimated daily average production: 350,000 bbl.; accumulative production to July 1, 1950: 306,000,000 bbl.; wells drilling: three; producing formation: Oligocene, Miocene; gravity: 35° A.P.I.

GACH SARAN—
Discovered: 1937; producing wells: four flowing; producing depth: 4,000-7,000 ft.; estimated daily average production: 41,000 bbl.; accumulative production to July 1, 1950: 113,000,000 bbl.; producing formation: Oligocene, Miocene; gravity: 33° A.P.I.

HAFT KEL—
Discovered: 1928; producing wells: 20 flowing; producing depth: 3,000-4,000 ft.; estimated daily average production: 190,000 bbl.; accumulative production to July 1, 1950: 932,000,000 bbl.; producing formation: Oligocene, Miocene; gravity: 38° A.P.I.

LALI—
Discovered 1946; producing wells four flowing; producing depth: 6,000-9,000 ft.; estimated daily average production: 16,000 bbl.; accumulative production to July 1, 1950: 849,000 bbl.; wells drilling: two; producing formation: Oligocene, Miocene; gravity: 37° A.P.I.

MASJID-I-SULAIMAN—
Discovered: 1908; producing wells: 30 flowing; producing depth: 2,000-3,000 ft.; estimated daily average production: 52,000 bbl.; accumulative production to July 1, 1950: 849,000,000 bbl.; producing formation: Oligocene, Miocene; gravity: 38° A.P.I.

NAFT-I-SHAH, NAFT KHANEH—
Discovered: 1923-1926; producing wells: four; producing depth: 2,600-3,000 ft.; estimated daily average production: 11,000 bbl.; accumulative production to July 1, 1950: 47,000,000 bbl.; producing formation: Oligocene, Miocene; gravity: 43° A.P.I.

NAFT-SAFID—
Discovered: 1938; producing wells: five; producing depth: 5,000-6,000 ft.; estimated daily average production: 33,000 bbl.; accumulative production to July 1, 1950: 26,000,000 bbl.; wells drilling: three; producing formation: Oligocene, Miocene; gravity: 40° A.P.I.

IRAQ

AIN ZALAH—
Discovered: 1940; producing wells: eight; producing depth: average 5,500 ft.; estimated daily average production: shut in; accumulative production to July 1, 1950: not produced yet; wells drilling: one; producing formation: Cretaceous limestone; gravity: 33° A.P.I.

ZUBAIR—
Discovered: 1949; producing wells: four flowing; producing depth: 11,000 ft.; estimated daily average production: shut in; wells drilling: four; producing formation: Cretaceous ss.; gravity: 33°-34° A.P.I.

NAHR UMR—
Discovered: 1949; producing wells: shut in; producing depth: 8,300 ft.; Cretaceous ss.; gravity: 33°-40° A.P.I.

KIRKUK—
Discovered: 1927; producing wells: 10; producing depth: average 2,750 ft.; estimated daily average production: 120,000 bbl.; accumulative production to July 1, 1950: 440,150,000 bbl.; wells drilling: three; producing formation: Qarah Chalk limestone; gravity: 36° A.P.I.

QAIYARAH—
Discovered: 1927; producing wells: one; producing depth: 840 ft.; estimated daily average production: shut in; accumulative production to July 1, 1950: not produced yet; producing formation: Miocene, Cretaceous; gravity: 16° A.P.I.

ITALY

VALLEZZA—
Discovered: 1909; producing wells: 155 pumping; producing depth: 1,600-2,400 ft.; estimated daily average production: 64 bbl.; accumulative production to July 1, 1950: 975,039 bbl.; producing formation: Tongrain, Oligocene; Gravity: 50° A.P.I.

VIZZOLA—
Discovered: 1942; producing wells: three pumping; producing depth: 1,900 ft.; estimated daily average production: 7 bbl.; accumulative production to July 1, 1950: 20,441 bbl.; producing formation: Tongrain, Oligocene; gravity: 40°-42° A.P.I.

Salsomaggiore Area

CENTOPOZZI—
Discovered: 1923; producing wells: 64; producing depth: 500-1,600 ft.; estimated daily average production: 14 bbl.; accumulative production to July 1, 1950: 509,630 bbl.; producing formation: Tongrain, Oligocene; gravity: 40°-42° A.P.I.

SALSOMAGGIORE—
Discovered: 1933; producing depth: 500-1,600 ft.; producing formation: Tongrain, Oligocene; gravity 40°-42° A.P.I.

SALSOMINORE—
Discovered: 1923; producing depth: 500-1,600 ft.; producing formation: Tongrain, Oligocene; gravity: 40°-42° A.P.I.

JAPAN

AKITA PREFECTURE—
Discovered: 1902; producing depth: 300-3,900 ft.; producing formation: Tertiary; gravity: 21°-40° A.P.I.

HOKKAIDA PREFECTURE—
Discovered: 1905.

NIIGATA PREFECTURE—
Discovered: 1874; producing depth: 1,000-4,500 ft.; producing formation: Tertiary; gravity: 17°-35° A.P.I.

SHIZOKU PREFECTURE—
Discovered: 1908.

YAMAGATA PREFECTURE—
Discovered: 1922; producing depth: 2,600-5,000 ft.; producing formation: Tertiary; gravity: 27°-37° A.P.I.

KUWAIT

BURGAN—
Discovered: 1938; producing wells: 73; producing depth: 3,500-4,800 ft.; estimated daily average production: 330,000 bbl.; accumulative production to July 1, 1950: 226,031,889 bbl.; wells drilling: two; producing formation: Middle Cretaceous; gravity: 31.8° A.P.I.

MEXICO
(Northeastern)

BRASIL—
Discovered: 1949; producing wells: three; producing depth: 8,578 ft.; estimated daily average production: 1 bbl.; accumulative production to July 1, 1950: 459 bbl.; wells drilling: two; producing formation: Frio, Oligocene; gravity: 55° A.P.I.

CAMARGO y VALADECES—
Discovered: 1947; gas field; producing depth: 4,399 ft.; producing formation: Marine, Vicksburg, Oligocene.

FRANCISCO CANO—
Discovered: 1949; producing wells: two; producing depth: 5,904 ft.; estimated daily average production: 214 bbl.; accumulative production to July 1, 1950: 51,087 bbl.; wells drilling: one; producing formation: Frio, Oligocene; gravity: 45° A.P.I.

LA PRESA—
Discovered: 1931; gas field; producing depth: 5,970 ft.; producing formation: Eocene sand.

LAREDO—
Discovered: 1937; gas field; producing depth: 2,000 ft.; producing formation: Eocene sand.

MIER—
Discovered: 1936; gas field; producing depth: 2,935 ft.; producing formation: Eocene sand.

MISION—
Discovered: 1945; producing wells: two; producing depth: 8,046 ft.; estimated daily average production: 55 bbl. (distillate); accumulative production to July 1, 1950: 99,721 bbl. distillate; producing formation: Oligocene.

MONTERREY—
Discovered: 1950; producing wells: one, flowing; producing depth: 9,840 ft.; wells drilling: one; producing formation: Oligocene sand; gravity: 55° A.P.I.

RANCHERIAS—
Discovered: 1933; gas field; producing depth: 6,265 ft.; producing formation: Eocene sand.

REYNOSA—
Discovered: 1948; producing wells: eight; producing depth: 10,548 ft.; estimated daily average production: 1,414 bbl.; accumulative production to July 1, 1950: 854,015 bbl.; wells drilling: one; producing formation: Oligocene; gravity: 61° A.P.I.

VALADECES—
Discovered: 1948; producing wells: one, flowing; producing depth: 6,210 ft.; estimated daily average production: 14 bbl.; accumulative production to July 1, 1950: 10,819 bbl.; producing formation: Eocene sand; gravity: 61° A.P.I.

Tampico Region

NORTHERN DISTRICT*—
Discovered: 1901; producing wells: 584; producing depth: 4,182 ft.; estimated daily average production: 25,135 bbl.; accumulative production to July 1, 1950: 817,470,044 bbl.; wells drilling: 14; producing formation: Lower Cretaceous; gravity: 12° A.P.I.

*Includes Elano, Panuco, Cacalila, etc.

SOUTHERN DISTRICT (Golden Lane)—
Discovered: 1908; producing wells: 199; producing depth: 2,300 ft.; estimated daily average production: 19,521 bbl.; accumulative production to July 1, 1950: 1,098,568,408 bbl.; wells drilling: 10; producing formation: mixed; gravity: 20° A.P.I.

ALAZAN—
Discovered: 1949; producing depth: 2,403 ft.; producing formation: Lower Cretaceous.

MORALILLO—
Discovered: 1948; producing wells: 19; producing depth: 5,700 ft.; estimated daily average production: 3,768 bbl.; accumulative production to July 1, 1950: 2,112,786 bbl.; wells drilling: one; producing formation: Lower Cretaceous; gravity: 21° A.P.I.

POZA RICA DISTRICT*—
Discovered: 1930; producing wells: 88; producing depth: 10,400 ft.; estimated daily average production: 126,347 bbl.; accumulative production to July 1, 1950: 387,718,475 bbl.; wells drilling: 10; producing formation: Lower Cretaceous; gravity: 30° A.P.I.

*Includes Mecatepec, Poza Rica, Potrero, Escolin, Pres. Aleman.

OTHER FIELDS*—
Accumulative production to July 1, 1950: 4,197,311 bbl.

*Includes San Sebastian, Tanhuijo, Mecatepec, Furbero.

CUICHAPA-ACALAPA—
Discovered: 1934; producing wells: 18; producing depth: 4,903 ft.; estimated daily average production: 1,905 bbl.; accumulative production to July 1, 1950: 3,527,545 bbl.; producing formation: Miocene; gravity: 30° A.P.I.

EL BURRO—
Discovered: 1930; producing wells: 28; producing depth: 5,423 ft.; estimated daily average production: 679 bbl.; accumulative production to July 1, 1950: 17,968,574 bbl.; producing formation: Miocene; gravity: 26° A.P.I.

EL PLAN—
Discovered: 1931; producing wells: 41 flowing, 51 pumping; producing depth: 10,100 ft.; estimated daily average production: 11,637 bbl.; accumulative production to July 1, 1950: 72,423,192 bbl.; wells drilling: six; producing formation: Miocene; gravity: 24°-35° A.P.I.

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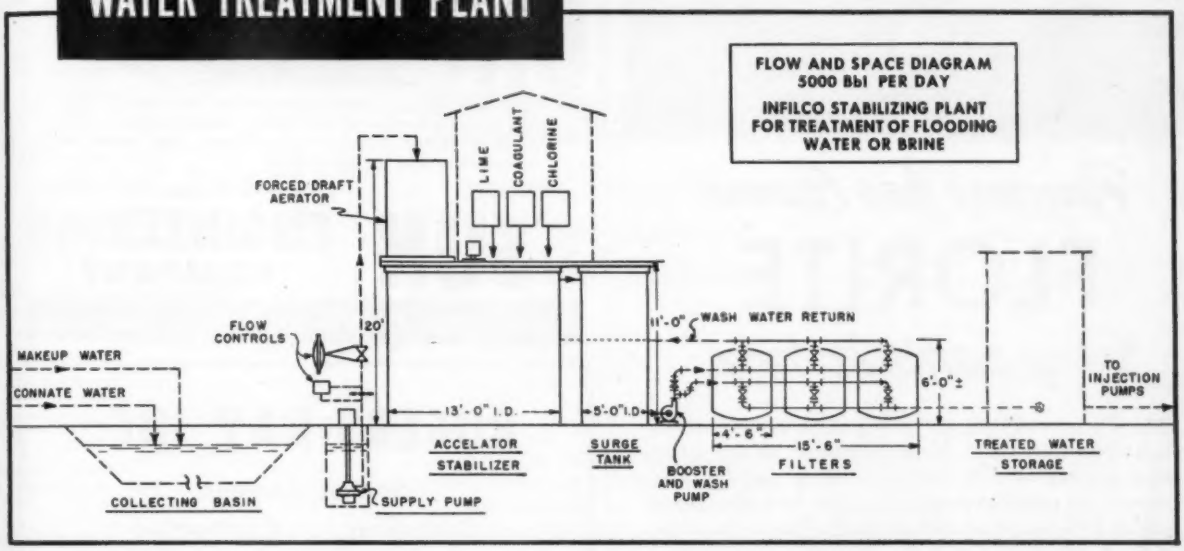
- **Automatic control of chemical feeds.**
- **No waste of filter wash water.**



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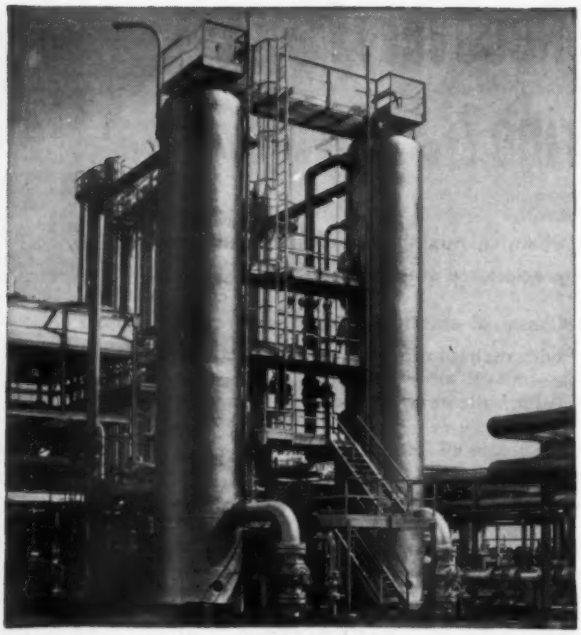

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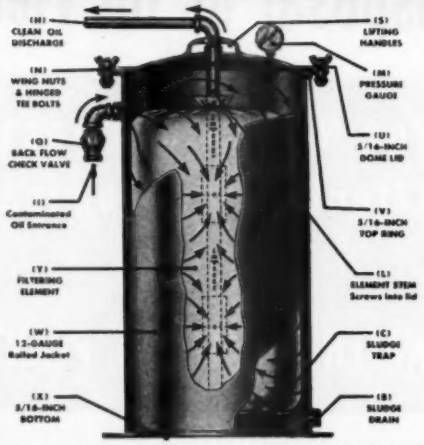
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FILISOLA—
Discovered: 1921; producing wells: 39; producing depth: 3,608 ft.; estimated daily average production: 837 bbl.; accumulative production to July 1, 1950: 21,790,089 bbl.; producing formation: Miocene; gravity: 22° A.P.I.

FORTUNA NACIONAL—
Discovered: 1949; producing wells: one;; producing depth: 7,320 ft.; estimated daily average production: 19 bbl.; accumulative production to July 1, 1950: 19,134 bbl.; wells drilling: one; producing formation: Miocene.

MOLOACAN—
Discovered: 1948; producing wells: seven; producing depth: 2,120 ft.; estimated daily average production: 340 bbl.; accumulative production to July 1, 1950: 134,637 bbl.; producing formation: Miocene.

TEAPA NUEVO—
Discovered: 1928; producing depth: 1,733 ft.; accumulative production to July 1, 1950: 230,635 bbl.; producing formation: Miocene; gravity: 36° A.P.I.

TOMALO—
Discovered: 1928; producing wells: 73; producing depth: 4,287 ft.; estimated daily average production: 2,069 bbl.; accumulative production to July 1, 1950: 230,635 bbl.; producing formation: Miocene; gravity: 36° A.P.I.

TORTUGUERO—
Discovered: 1950; producing wells: one flowing; accumulative production to July 1, 1950: 14,631 bbl.; wells drilling: one; producing formation: Miocene sand; gravity: 28° A.P.I.

OTHER FIELDS*—
Accumulative production to July 1, 1950: 378,532 bbl.

*Includes San Cristobal, Capoacan, Concepcion, Tecuanapa, Ixhautlan, Belam, Sarlat, etc.

NETHERLANDS

SCHOONEBEEK—
Discovered: 1943; producing wells: 106; producing depth: 2,500 ft.; estimated daily average production: 175 bbl.; accumulative production to July 1, 1950: 2,498,600 bbl.; wells drilling: one; producing formation: Lower Cretaceous sd.; gravity: 24.8° A.P.I.

PAKISTAN

BALKASSAR—
Discovered: 1946; producing depth: 8,200 ft.; producing formation: Eocene lime; gravity: 26° A.P.I.

DHULIAN—
Discovered: 1937; producing depth: 7,600 ft.; producing formation: Eocene lime; gravity: 35° A.P.I.

JOYA MAIR—
Discovered: 1944; producing depth: 8,200 ft.; producing formation: Eocene lime; gravity: 22° A.P.I.

KHAUR—
Discovered: 1915; producing depth: 5,200 ft.; producing formation: Eocene and Upper Tertiary sands; gravity: 37° A.P.I.

PERU

AGUA CALIENTE—
Discovered: 1938; producing wells: five flowing; producing depth: 1,020-1,080 ft.; estimated daily average production: 450 bbl.; accumulative production to July 1, 1950: 625,000 bbl.; producing formation: Middle Cretaceous sand; gravity: 44° A.P.I.

COPE—
Discovered: 1938; producing wells: 10 pumping; producing depth: 650 ft.; estimated daily average production: 10 bbl.; accumulative production to July 1, 1950: 212,019 bbl.; producing formation: Tertiary sand; gravity: 34.6° A.P.I.

LA BREA-PARINAS—
Discovered: 1888; producing wells: 226* flowing, 1,982 pumping; producing depth: 500-7,000 ft.; estimated daily average production: 31,400 bbl.; accumulative production to July 1, 1950: 317,800,000 bbl.; wells drilling: nine; producing formation: Eocene sands; gravity: 34.4°-37.6° A.P.I.

*Includes five gas wells.

ORGANOS—
Discovered: 1863; producing wells: 19 pumping; producing depth: 2,000 ft.; estimated average daily production: 320 bbl.; wells drilling: four; producing formation: Tertiary sand; gravity: 42.4° A.P.I.

RESTIN-EL ALTO-LOBITOS—
Discovered: 1904; producing wells: 730; producing depth: 1,800-2,400 ft.; estimated daily average production: 5,200 bbl.; accumulative production to July 1, 1950: 71,600,000 bbl.; producing formation: Upper Eocene sand; gravity: 34°-36° A.P.I.

ZORRITOS—
Discovered: 1863; producing wells: 34 pumping; producing depth: 2,000 ft.; estimated daily average production: 35 bbl.; accumulative production to July 1, 1950: 3,571,006 bbl.; wells drilling: one; producing formation: Tertiary sand; gravity: 36.8° A.P.I.

POLAND

BOBRKA—
Discovered: 1858.

GORLICE-LIPINSKI—
Discovered: 1865.

GRABOWNICA—
Discovered: 1896.

HARKLOWA—
Discovered: 1870.

TURASZOWKA—
Discovered.

WANKOWA—
Discovered: 1885.

ZMIENNICA—
Discovered: 1896.

*U.S.S.R. dominated, reliable current data not available.

QATAR

DUKHAN—
Discovered: 1940; producing wells: 11 flowing; producing depth: 6,000 ft.; estimated daily average production: 33,000 bbl.; accumulative production to July 1, 1950: 5,903,000 bbl.; wells drilling: two; produc-

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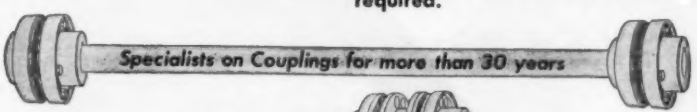

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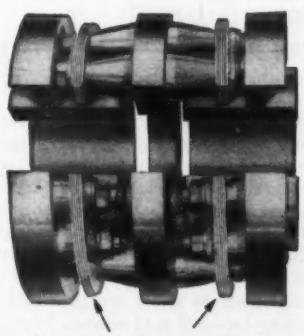

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ing formation: Jurassic; gravity: 36° A.P.I.

ROMANIA*

BAICOI†—
Discovered: 1861; producing depth: 600-9,800 ft.; producing formation: Pliocene, Dacic, and Meotic; gravity: 39° A.P.I.

BOLDESTI—
Discovered: 1922; producing depth: 6,900-7,900 ft.; producing formation: Pliocene, Dacic, and Meotic; gravity: 37° A.P.I.

BUCSANI—
Discovered: 1933; producing depth: 6,500-7,300 ft.; producing formation: Pliocene, Dacic, and Meotic; gravity: 38° A.P.I.

CEPTURA—
Discovered: 1913; producing depth: 2,400-4,100 ft.; producing formation: Pliocene, Dacic, and Meotic; gravity: 34° A.P.I.

FLORESTI‡—
Discovered: 1933; producing depth: 6,900-7,500 ft.; producing formation: Pliocene; gravity: 39° A.P.I.

GURA OCNITEI§—
Discovered: 1929; producing depth: 5,400-5,900 ft.; producing formation: Pliocene, Dacic, and Miocene; gravity: 33° A.P.I.

MARGINENI—
Discovered: 1935; producing depth: 6,100-7,500 ft.; producing formation: Pliocene (Dacic) and Miocene (Helvation); gravity: 39° A.P.I.

MORENI¶—
Discovered: 1903; producing depth: 1,400-5,600 ft.; producing formation: Pliocene (Meotic-Dacic).

PACURETI—
Discovered: 1899; producing depth: 2,000-4,000 ft.; producing formation: Pliocene (Dacic, Pontic, Meotic).

PISCURI‖—
Discovered: 1927; producing depth: 1,200-4,000 ft.; producing formation: Pliocene, Meotic; gravity: 33° A.P.I.

*U.S.S.R. dominated, no reliable data available subsequent to 1948. †Includes Liliesti and Tintea. ‡Includes Ditesti and Calinesti. §Includes W. Gura Ocnitei, Ochiuri, and Rasvad. ¶Includes Ghirdoveni. ‖Includes Filipesti de Padure.

SAUDI ARABIA

ABQAIQ—
Discovered: 1941; producing wells: 59 flowing; producing depth: 5,600 ft.; estimated daily average production: 385,370 bbl.; accumulative production to July 1, 1950: 391,747,659 bbl.; wells drilling: one; producing formation: Jurassic; gravity: 39° A.P.I.

ABU RADRIYA—
Discovered: 1940; producing wells: one flowing; producing depth: 10,115 ft.; estimated daily average production: shut in; accumulative production to July 1, 1950: 9,579 bbl.; producing formation: Jurassic; gravity: 34° A.P.I.

AIN DAR—
Discovered: 1948; shut in; producing depth: 6,623 ft.; wells drilling: one; producing formation: Jurassic; gravity: 34° A.P.I.

DAMMAM—
Discovered: 1936; producing wells: 33 flowing; producing depth: 4,200 ft.; estimated daily average production: 90,827 bbl.; accumulative production to July 1, 1950: 202,887,856 bbl.; producing formation: Jurassic; gravity: 34° A.P.I.

FADHILI—
Discovered: 1949; shut in; producing depth: 9,786 ft.; producing formation: Jurassic; gravity: 38° A.P.I.

HARADH—
Discovered: 1949; shut in; producing depth: 6,185 ft.; producing formation: Jurassic; gravity: 34° A.P.I.

QATIF—
Discovered: 1945; producing wells: 10 flowing; producing depth: 6,912 ft.; estimated daily average production: 12,827 bbl.; accumulative production to July 1, 1950: 12,944,349 bbl.; producing formation: Jurassic; gravity: 30°-38° A.P.I.

TRINIDAD

BARRACKPORE—
Discovered: 1918; producing wells: 14 flowing, 35 pumping; producing depth: 500-10,000 ft.; estimated daily average production: 1,460 bbl.; accumulative production to July 1, 1950: 7,766,169 bbl.; wells drilling: one; producing formation: Miocene; gravity: 27° A.P.I.

BRIGHTON—
Discovered: 1910; producing depth: 700-3,000 ft.; producing formation: Miocene; gravity: 18° A.P.I.

COORA-QUARRY—
Discovered: 1936; producing depth: 1,200-6,500 ft.; producing formation: Miocene; gravity: 26° A.P.I.

CRUSE—
Discovered: 1913; producing wells: 19 flowing, 79 pumping; producing depth: 2,000-4,000 ft.; estimated daily average production: 2,100 bbl.; accumulative production to July 1, 1950: 16,121,961 bbl.; producing formation: Miocene; gravity: 21° A.P.I.

FOREST RESERVE—
Discovered: 1914; producing wells: 127 flowing, 265 pumping; producing depth: 100-8,000 ft.; estimated daily average production: 14,300 bbl.; accumulative production to July 1, 1950: 98,612,561 bbl.; wells drilling: four; producing formation: Miocene; gravity: 24° A.P.I.

FYZABAD—
Discovered: 1920; producing wells: 79 flowing, 213* pumping; producing depth: 300-8,000 ft.; estimated daily average production: 7,900 bbl.; accumulative production to July 1, 1950: 84,300,000 bbl.; wells drilling: three; producing formation: Miocene; gravity: 24° A.P.I.

GUAPO—
Producing depth: 1,500-5,700 ft.

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GUAYAGUAYARE—
Discovered: 1902; producing wells: 9 flowing, 57 pumping; producing depth: 500-6,000 ft.; estimated daily average production: 2,035 bbl.; accumulative production to July 1, 1950: 17,836,974 bbl.; wells drilling: one; producing formation: Miocene; gravity: 31° A.P.I.

MORNE DIABLO—
Discovered: 1936; producing wells: 4 flowing, 20 pumping; producing depth: 2,500-4,000 ft.; estimated daily average production: 670 bbl.; accumulative production to July 1, 1950: 4,687,103 bbl.; wells drilling: one; producing formation: Miocene; gravity: 25° A.P.I.

NEW DOME—
Producing wells: nine pumping; producing depth: 1,000-2,500 ft.; estimated daily average production: 89 bbl.; accumulative production to July 1, 1950: 2,326,557† bbl.; producing formation: Miocene; gravity: 26° A.P.I.

QUINAM—
Discovered: 1936; producing wells: 2 flowing, 11 pumping; producing depth: 1,500-4,000 ft.; estimated daily average production: 275 bbl.; accumulative production to July 1, 1950: 1,352,695 bbl.; wells drilling: one; producing formation: Miocene; gravity: 31° A.P.I.

PALO SECO—
Discovered: 1927; producing wells: 8 flowing, 43 pumping; producing depth: 1,500-6,000 ft.; estimated daily average production: 1,620 bbl.; accumulative production to July 1, 1950: 4,413,387 bbl.; wells drilling: one; producing formation: Miocene; gravity: 21° A.P.I.

PARRYLANDS—
Discovered: 1913; producing depth: 2,000-4,000 ft.; producing formation: Miocene; gravity: 26° A.P.I.

PENAL—
Discovered: 1935; producing wells: 36 flowing, 64‡ pumping; producing depth: 9,685 ft.; estimated daily average production: 6,130 bbl.; accumulative production to July 1, 1950: 16,721,261 bbl.; wells drilling: two; producing formation: Miocene, Oligocene; gravity: 23° A.P.I.

POINT FORTIN—
Discovered: 1908; producing wells: 166 flowing, 139¶ pumping; producing depth: 1,000-9,450 ft.; estimated daily average production: 8,500§ bbl.; accumulative production to July 1, 1950: 61,423,069§ bbl.; wells drilling: two; producing formation: Miocene; gravity: 20° A.P.I.

SAN FRANCIQUE—
Discovered: 1922; producing wells: 17 pumping; producing depth: 1,000- 2,800 ft.; estimated daily average production: 239 bbl.; accumulative production to July 1, 1950: 4,773,679 bbl.; gravity: 23° A.P.I.

T.P.D.—
Discovered: 1926; producing wells: 100 flowing, 267 pumping; producing depth: 1,500-6,500 ft.; estimated daily average production: 7,600 bbl.; accumulative production to July 1, 1950: 47,000,000 bbl.‡ wells drilling: five; producing formation: Miocene; gravity: 25° A.P.I.

WILSON—
Discovered: 1918; producing wells: 8 flowing, 30 pumping; producing depth: 500-3,500 ft.; estimated daily average production: 1,050 bbl.; accumulative production to July 1, 1950: 3,787,639 bbl.; producing formation: Miocene, Oligocene; gravity: 21° A.P.I.

*Includes 50 wells on artificial lift. †Cumulative production from April 1948. ‡Includes 27 wells on artificial lift. ¶Includes nine wells on artificial lift. §Includes Los Bajos and Cedros.

TURKEY

RAMANDAG—
Discovered: 1948; producing wells: 4 pumping; producing depth: 4,400 ft.; estimated daily average production: 3,000* bbl.; accumulative production to July 1, 1950: 46,000 bbl.; wells drilling: three; producing formation: Upper Cretaceous lime; gravity: 20° A.P.I.

*Potential.

VENEZUELA—EASTERN

ANACO—
Discovered: 1940; producing depth: 10,000 ft.; accumulative production to July 1, 1950: 15,317 bbl.; producing formation: Miocene, Oligocene; gravity: 43.4° A.P.I.

ARAGUA—
Discovered: 1950; producing wells: 1 flowing; estimated daily average production: 592; accumulative production to July 1, 1950: 23,253 bbl.; wells drilling: one; producing formation: Oligocene; gravity: 53° A.P.I.

AREO—
Discovered: 1937; producing wells: 6; producing depth: 5,700 ft.; accumulative production to July 1, 1950: 40,248 bbl.; producing formation: Miocene, Oligocene; gravity: 32° A.P.I.

CACIO SECO—
Discovered: 1946; producing wells: 3 flowing; producing depth: 6,560-7,300 ft.; estimated daily average production: 931 bbl.; accumulative production to July 1, 1950: 805,400 bbl.; wells drilling: one; producing formation: Miocene, Oligocene; gravity: 43° A.P.I.

CAPACHO—
Discovered: 1945; producing depth: 4,400-4,500 ft.; accumulative production to July 1, 1950: 7,000 bbl.; producing formation: Miocene, Oligocene; gravity: 23.1° A.P.I.

CHIMIRE—
Discovered: 1948; producing wells: 58; producing depth: 7,000-7,200 ft.; estimated daily average production: 40,400 bbl.; accumulative production to July 1, 1950: 12,658,-432 bbl.; wells drilling: five; producing formation: Miocene, Oligocene; gravity: 24°-36.4° A.P.I.

EL ROBLE—
Discovered: 1939; producing wells: 42; producing depth: 8,040-11,560 ft.; estimated daily average production: 8,300 bbl.; accumulative production to July 1, 1950: 24,540,-

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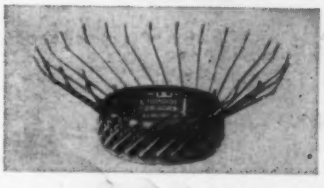

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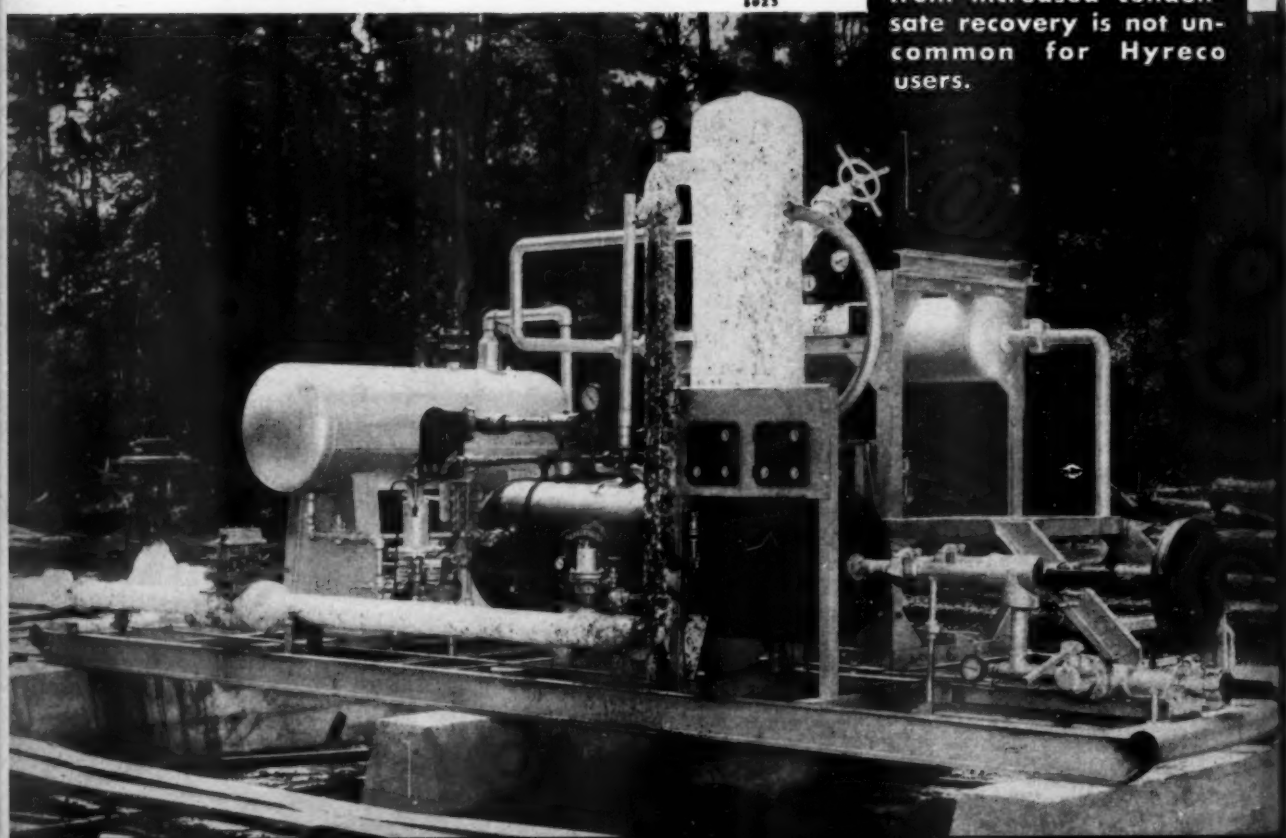

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414 bbl.; producing formation: Miocene, Oligocene; gravity: 52.2° A.P.I.

EL TOPO—
Discovered: 1948; producing wells: 4; producing depth: 9,000 ft.; estimated daily average production: 1,700 bbl.; accumulative production to July 1, 1950: 1,465,714 bbl.; wells drilling: two; producing formation: Eocene; gravity: 43° A.P.I.

FRIA—
Discovered: 1948; producing wells: 4 flowing, 3 pumping; producing depth: 6,200 ft.; estimated daily average production: 830 bbl.; accumulative production to July 1, 1950: 810,632 bbl.; producing formation: Miocene; gravity: 36° A.P.I.

GRICO—
Discovered: 1946; shut in; producing depth: 4,100 ft.; producing formation: Oligocene; gravity: 30° A.P.I.

GUARA—
Discovered: 1942; producing wells: 177 flowing, 34 pumping; producing depth: 6,700 ft.; estimated daily average production: 57,200 bbl.; accumulative production to July 1, 1950: 144,011,682 bbl.; wells drilling: one; producing formation: Miocene, Oligocene; gravity: 36° A.P.I.

GUARIO—
Discovered: 1940; producing wells: 22 flowing; producing depth: 5,000-10,000 ft.; estimated daily average production: 4,900 bbl.; accumulative production to July 1, 1950: 12,437,130 bbl.; producing formation: Miocene, Oligocene; gravity: 44.3° A.P.I.

GUAVINITA—
Discovered: 1948; producing wells: 8 flowing; producing depth: 3,500 ft.; estimated daily average production: 900 bbl.; accumulative production to July 1, 1950: 345,647 bbl.; wells drilling: one; producing formation: Oligocene; gravity: 30° A.P.I.

GUICO—
Discovered: 1944; producing wells: 25 flowing; producing depth: 4,500-7,800 ft.; estimated daily average production: 8,800 bbl.; accumulative production to July 1, 1950: 21,110,603 bbl.; producing formation: Miocene; gravity: 41.1° A.P.I.

GUICO (SOUTH)—
Discovered: 1946; producing wells: six flowing; producing depth: 4,500-7,000 ft.; estimated daily average production: 1,400 bbl.; accumulative production to July 1, 1950: 3,812,875 bbl.; producing formation: Miocene; gravity: 36.6° A.P.I.

GUICO (WEST)—
Discovered: 1946; producing wells: 6 flowing; producing depth: 4,500-7,000 ft.; estimated daily average production: 1,000 bbl.; accumulative production to July 1, 1950: 2,041,592 bbl.; producing formation: Miocene; gravity: 34.5° A.P.I.

JUSEPIN—
Discovered: 1938; producing wells: 207 flowing, 31 pumping; producing depth: 3,000-5,300 ft.; estimated daily average production: 24,000 bbl.; accumulative production to July 1, 1950: 1233,266,000 bbl.; producing formation: Miocene, Oligocene; gravity: 23.3° A.P.I.

LA CEIBA—
Discovered: 1945; producing wells: one flowing; producing depth: 7,700 ft.; estimated daily average production: 131 bbl.; accumulative production to July 1, 1950: 277,115 bbl.; producing formation: Oligocene; gravity: 36° A.P.I.

LA LOMA—
Discovered: 1950; producing wells: one flowing; estimated daily average production: 193 bbl.; accumulative production to July 1, 1950: 13,542 bbl.; producing formation: Miocene, Oligocene; gravity: 60° A.P.I.

LAS OLLAS—
Discovered: 1942; producing depth: 7,300-7,400 ft.; accumulative production to July 1, 1950: 5,000 bbl.; producing formation: Miocene; gravity: 42° A.P.I.

LEONA—
Discovered: 1938; producing wells: 17 flowing, 3 pumping; producing depth: 8,000 ft.; estimated daily average production: 5,200 bbl.; accumulative production to July 1, 1950: 11,485,527 bbl.; wells drilling: one; producing formation: Miocene, Oligocene; gravity: 28° A.P.I.

LOS CARITOS—
Discovered: 1939; producing depth: 5,641 ft.; accumulative production to July 1, 1950: 255,833 bbl.; producing formation: Miocene, Oligocene; gravity: 30° A.P.I.

MATA GRANDE—
Discovered: 1946; producing wells: 19 flowing; producing depth: 4,750 ft.; estimated daily average production: 1,300 bbl.; accumulative production to July 1, 1950: 1,736,160 bbl.; producing formation: Miocene; gravity: 27.8° A.P.I.

MERCEDES—
Discovered: 1941; producing wells: 108 flowing; producing depth: 4,160-4,500 ft.; estimated daily average production: 18,407 bbl.; accumulative production to July 1, 1950: 11,622,847 bbl.; wells drilling: seven; producing formation: Oligocene; gravity: 26°-36° A.P.I.

MULATA—
Discovered: 1941; producing wells: 179 flowing, 70 pumping; producing depth: 3,500-6,660 ft.; estimated daily average production: 27,400 bbl.; accumulative production to July 1, 1950: 80,514,126 bbl.; producing formation: Miocene; gravity: 35.8° A.P.I.

MURI—
Discovered: 1942; producing wells: 50 flowing, 2 pumping; producing depth: 4,500 ft.; estimated daily average production: 2,037 bbl.; accumulative production to July 1, 1950: 11,926,819 bbl.; producing formation: Miocene; gravity: 32° A.P.I.

NIPA—
Discovered: 1945-1946; producing wells: 117 flowing, 1 pumping; producing depth: 6,000-8,500 ft.; estimated daily average production: 39,600 bbl.; accumulative production to July 1, 1950: 31,668,196 bbl.; wells drilling: four; producing formation: Miocene; gravity: 34°-39.2° A.P.I.

OFICINA—
Discovered: 1937; producing wells: 100 flowing, 94 pumping; producing depth: 5,900 ft.; estimated daily average production: 39,800 bbl.; accumulative production to July 1, 1950: 159,544,446 bbl.; wells drilling: one; producing formation: Miocene, Oligocene; gravity: 32° A.P.I.

ORACUAL—
Discovered: 1933; producing depth: 2,600-3,190 ft.; accumulative production to July 1, 1950: 30,000 bbl.; producing formation: Miocene, Pliocene; gravity: 13° A.P.I.

PALACIO—
Discovered: 1946; producing wells: 42 flowing; producing depth: 3,400 ft., estimated daily average production: 5,700 bbl.; accumulative production to July 1, 1950: 3,451,422 bbl.; producing formation: Oligocene; gravity: 30° A.P.I.

PEDERNALES—
Discovered: 1933; producing wells: 9 flowing; producing depth: 1,571 ft.; estimated daily average production: 9,432 bbl.; accumulative production to July 1, 1950: 14,293,924 bbl.; wells drilling: one; producing formation: Miocene; gravity: 21°-24° A.P.I.

PELAYO—
Discovered: 1947; producing wells: two flowing; producing depth: 7,400 ft.; estimated daily average production: 156 bbl.; accumulative production to July 1, 1950: 217,916 bbl.; producing formation: Oligocene; gravity: 32° A.P.I.

PIRITAL—
Discovered: 1945; estimated daily average production: 100 bbl.; accumulative production to July 1, 1950: 88,560 bbl.; producing formation: Miocene; gravity: 30°-35° A.P.I.

QUIAMARE—
Discovered: 1942; producing wells: one flowing; producing depth: 7,000 ft.; estimated daily average production: 60 bbl.; accumulative production to July 1, 1950: 702,592 bbl.; producing formation: Miocene, Oligocene; gravity: 38° A.P.I.

QUIRIQUIRE—
Discovered: 1928; producing wells: 43 flowing, 338 pumping; producing depth: 650-5,100 ft.; estimated daily average production: 63,100 bbl.; accumulative production to July 1, 1950: 336,175,000 bbl.; wells drilling: two; producing formation: Pliocene; gravity: 17.4° A.P.I.

RINCON LARGO—
Discovered: 1941; producing wells: four flowing; producing depth: 6,500-8,000 ft.; estimated daily average production: 1,550 bbl.; accumulative production to July 1, 1950: 4,082,732 bbl.; producing formation: Miocene, Oligocene; gravity: 42° A.P.I.

SABAN—
Discovered: 1947; producing wells: five; producing depth: 2,600 ft.; estimated daily average production: 209 bbl.; accumulative production to July 1, 1950: 163,974 bbl.; producing formation: Oligocene; gravity: 43° A.P.I.

SAN JOAQUIN—
Discovered: 1939; producing wells: 38 flowing; producing depth: 6,560 ft.; estimated daily average production: 8,519 bbl.; accumulative production to July 1, 1950: 30,883,103 bbl.; wells drilling: one; producing formation: Miocene; gravity: 44° A.P.I.

SAN ROQUE—
Discovered: 1949; producing wells: 19 flowing; producing depth: 8,500 ft.; estimated daily average production: 6,400 bbl.; accumulative production to July 1, 1950: 2,388,100 bbl.; wells drilling: five; producing formation: Oligocene; gravity: 50.4° A.P.I.

SANTA ANA—
Discovered: 1936; producing wells: 10 flowing; producing depth: 8,500 ft.; estimated daily average production: 3,800 bbl.; accumulative production to July 1, 1950: 3,124,067 bbl.; wells drilling: two; producing formation: Miocene, Eocene, Oligocene; gravity: 39° A.P.I.

SANTA BARBARA—
Discovered: 1941; producing wells: 185 flowing, 33 pumping; producing depth: 5,000-6,500 ft.; estimated daily average production: 15,983 bbl.; accumulative production to July 1, 1950: 64,205,465 bbl.; producing formation: Miocene; gravity: 32° A.P.I.

SANTA ROSA—
Discovered: 1941; producing wells: 13 flowing; producing depth: 11,000 ft.; estimated daily average production: 4,200 bbl.; accumulative production to July 1, 1950: 6,842,909 bbl.; producing formation: Miocene, Eocene, Oligocene; gravity: 44° A.P.I.

SOCORORO—
Discovered: 1940; producing depth: 4,000 ft.; accumulative production to July 1, 1950: 12,000 bbl.; producing formation: Miocene, Oligocene; gravity: 27° A.P.I.

SOTO—
Discovered: 1948; producing wells: four flowing; estimated daily average production: 2,969 bbl.; accumulative production to July 1, 1950: 240,414; wells drilling: three; producing formation: Miocene; gravity: 39° A.P.I.

TAMAN—
Discovered: 1949; producing wells: 15 flowing, 2 pumping; estimated daily average production: 8,476 bbl.; accumulative production to July 1, 1950: 2,589,691 bbl.; producing formation: Miocene; gravity: 39° A.P.I.

TEMBLADOR—
Discovered: 1936; producing wells: 84 flowing; producing depth: 3,310-4,500 ft.; estimated daily average production: 9,300 bbl.; accumulative production to July 1, 1950: 33,622,000 bbl.; producing formation: Miocene, Oligocene; gravity: 21.2° A.P.I.

TRAVIESO—
Discovered: 1946; producing wells: nine pumping; producing depth: 4,000 ft.; estimated daily average production: 266 bbl.; accumulative production to July 1, 1950:

901,619 bbl.; producing formation: Miocene; gravity: 32° A.P.I.

TUCUPIDO (DEEP)—

Discovered: 1947; producing wells: 27 flowing; producing depth: 5,600 ft.; estimated daily average production: 7,457 bbl.; accumulative production to July 1, 1950: 5,435,556 bbl.; producing formation: Miocene, Oligocene; gravity: 40° A.P.I.

TUCUPIDO (SHALLOW)—

Discovered: 1947; producing wells: 25 flowing; producing depth: 2,800-3,500 ft.; estimated daily average production: 9,984 bbl.; accumulative production to July 1, 1950: 2,606,769 bbl.; producing formation: Miocene, Oligocene; gravity: 40° A.P.I.

TUCUPITA—

Discovered: 1945; producing wells: 40 flowing; producing depth: 5,600 ft.; estimated daily average production: 7,300 bbl.; accumulative production to July 1, 1950: 7,057,799 bbl.; producing formation: Miocene; gravity: 16° A.P.I.

URACOA—

Discovered: 1937; producing depth: 4,290-4,380 ft.; accumulative production to July 1, 1950: 46,000 bbl.; producing formation: Miocene, Oligocene; gravity: 15° A.P.I.

YOPALES—

Discovered: 1937; producing wells: 10 flowing, 5 pumping; producing depth: 4,600 ft.; estimated daily average production: 2,300 bbl.; accumulative production to July 1, 1950: 3,086,136 bbl.; producing formation: Miocene, Oligocene; gravity: 24° A.P.I.

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VENEZUELA (WESTERN)

AMANA—

Discovered: 1928; producing wells: two flowing; producing depth: 3,000-4,000 ft.; estimated daily average production: 100 bbl.; accumulative production to July 1, 1950: 112,000 bbl.; wells drilling: three; producing formation: Eocene; gravity: 31° A.P.I.

BACHAQUERO—

Discovered: 1930; producing wells: 413 flowing, 166 pumping; producing depth: 3,444 ft.; estimated daily average production: 124,477 bbl.; accumulative production to July 1, 1950: 176,969,777 bbl.; wells drilling: seven; producing formation: Miocene; gravity: 13° A.P.I.

BOLIVAR COASTAL*—

Discovered: 1917-1945; producing wells: 647 flowing, 1,085 pumping; producing depth: 1,200-6,200 ft.; estimated daily average production: 539,700 bbl.; accumulative production to July 1, 1950: 2,130,395,488 bbl.; wells drilling: three; producing formation: Miocene, Eocene, Oligocene; gravity: 13°-32.2° A.P.I.

BOSCAN—

Discovered: 1946; producing wells: 44 pumping; producing depth: 6,500-7,500 ft.; estimated daily average production: 12,000 bbl.; accumulative production to July 1, 1950: 3,150,000 bbl.; producing formation: Eocene; gravity: 10°-11° A.P.I.

CABIMAS—

Discovered: 1917; producing wells: 130 flowing, 719 pumping; producing depth: 2,198 ft.; estimated daily average production: 82,196 bbl.; accumulative production to July 1, 1950: 624,246,917 bbl.; wells drilling: five; producing formation: Miocene, Oligocene; gravity: 21° A.P.I.

CUMAREBO—

Discovered: 1913; producing wells: 28 flowing, 19 pumping; producing depth: 1,900 ft.; estimated daily average production: 3,557 bbl.; accumulative production to July 1, 1950: 41,715,849 bbl.; producing formation: Miocene; gravity: 47° A.P.I.

EL CUBO—

Discovered: 1916; producing wells: 28 flowing, 101 pumping; producing depth: 984 ft.; estimated daily average production: 12,560 bbl.; accumulative production to July 1, 1950: 115,437,560 bbl.; wells drilling: two; producing formation: Eocene; gravity: 33° A.P.I.

EL MENE—

Discovered: 1921; producing wells: 38 pumping; producing depth: 1,000 ft.; estimated daily average production: 400 bbl.; accumulative production to July 1, 1950: 23,250,000 bbl.; producing formation: Miocene; gravity: 33° A.P.I.

EL MENITO—

Discovered: 1925; producing depth: 2,000 ft.; accumulative production to July 1, 1950: 6,670 bbl.; producing formation: Eocene; gravity: 15° A.P.I.

ENSENADA—

Discovered: 1948; accumulative production to July 1, 1950: 38,300 bbl.; wells drilling: one; producing formation: Tertiary; gravity: 44° A.P.I.

HOMBRE PINTADO—

Discovered: 1927; producing wells: 28 pumping; producing depth: 600-1,850 ft.; estimated daily average production: 600 bbl.; accumulative production to July 1, 1950: 4,400,000 bbl.; wells drilling: one; producing formation: Miocene; gravity: 25° A.P.I.

INCA—

Discovered: 1948; producing wells: one flowing; producing depth: 7,100 ft.; estimated daily average production: 500 bbl.; accumulative production to July 1, 1950: 101,585 bbl.; producing formation: Miocene, Oligocene; gravity: 41° A.P.I.

LA CONCEPCION—

Discovered: 1935; producing wells: 1 flowing, 56 pumping; producing depth: 3,148 ft.; estimated daily average production: 4,099 bbl.; accumulative production to July 1, 1950: 34,520,608 bbl.; producing formation: Eocene; gravity: 36° A.P.I.

LAGUNILLAS—
Discovered: 1926; producing wells: 299 flowing, 1,044 pumping; producing depth: 3,001 ft.; estimated daily average production: 404,498 bbl.; accumulative production to July 1, 1950: 1,835,475 bbl.; wells drilling: 10; producing formation: Miocene, Eocene; gravity: 17° A.P.I.

LAS PALMAS—
Discovered: 1928; producing depth: 2,100-5,400 ft.; accumulative production to July 1, 1950: 381,000 bbl.; producing formation: Miocene, Oligocene; gravity: 33° A.P.I.

LA PAZ—
Discovered: 1925; producing wells: 45 flowing, 11 pumping; producing depth: 4,264 ft.; estimated daily average production: 166,759 bbl.; accumulative production to July 1, 1950: 181,496,619 bbl.; wells drilling: five; producing formation: Eocene; gravity 34° A.P.I.

LOS BARROSSOS—
Discovered: 1922; producing depth: 642-802 ft.

MAPIRI—
Discovered: 1949; producing wells: three; producing depth: 10,500 ft.; estimated daily average production: 2,700 bbl.; accumulative production to July 1, 1950: 240,418 bbl.; wells drilling: two; producing formation: Miocene, Oligocene; gravity: 43° A.P.I.

MARA—
Discovered: 1945; producing wells: 29 flowing; producing depth: 5,248 ft.; estimated daily average production: 78,289 bbl.; accumulative production to July 1, 1950: 70,541,245 bbl.; wells drilling: 13; producing formation: Cretaceous; gravity: 30° A.P.I.

MENE GRANDE—
Discovered: 1914; producing wells: 37 flowing, 279 pumping; producing depth: 4,132 ft.; estimated daily average production: 46,316 bbl.; accumulative production to July 1, 1950: 346,511,085 bbl.; wells drilling: four; producing formation: Eocene; gravity: 16° A.P.I.

MENE MAUROA—
Producing wells: 6 flowing, 19 pumping; estimated daily average production: 413 bbl.; accumulative production to July 1, 1950: 24,901,753 bbl.; gravity: 33° A.P.I.

MEREY—
Discovered: 1937; producing wells: six (shut in); producing depth: 5,700 ft.; estimated daily average production: 330 bbl.; accumulative production to July 1, 1950: 263,462 bbl.; producing formation: Pleistocene; gravity: 18° A.P.I.

MISOA—
Discovered: 1921; producing depth: 518-908 ft.; accumulative production to July 1, 1950: 8,000 bbl.; producing formation: Eocene; gravity: 15° A.P.I.

MONTE CARLO—
Discovered: 1926; producing depth: 272-618 ft.; accumulative production to July 1, 1950: 11,000 bbl.; producing formation: Miocene, Oligocene; gravity: 35° A.P.I.

NETICK—
Discovered: 1928; producing depth: 8,268 ft.; estimated daily average production: 30 bbl.; accumulative production to July 1, 1950: 714,277 bbl.; producing formation: Eocene; gravity: 28° A.P.I.

PIRAGUA—
Discovered: 1949; shut in; producing depth: 3,500 ft.; producing formation: Oligocene; gravity: 41° A.P.I.

PUEBLO VIEJO—
Discovered: 1940; producing wells: 10 flowing, 7 pumping; producing depth: 1,968 ft.; estimated daily average production: 5,663 bbl.; accumulative production to July 1, 1950: 10,403,545 bbl.; wells drilling: one; producing formation: Eocene; gravity: 18° A.P.I.

RUIZ—
Discovered: 1949: producing wells: 31 flowing; producing depth: 4,450 ft.; estimated daily average production: 4,865 bbl.; accumulative production to July 1, 1950: 1,063,236 bbl.; wells drilling: three; producing formation: Oligocene; gravity: 29°-36° A.P.I.

SAN JOSE—
Discovered: 1948; accumulative production to July 1, 1950: 7,434 bbl.; producing formation: Miocene; gravity: 12° A.P.I.

SIBUCARA—
Discovered: 1948; producing wells: one; producing depth: 13,451 ft.; estimated daily average production: 8,358 bbl.; accumulative production to July 1, 1950: 3,871,459 bbl.; wells drilling: one; producing formation: Cretaceous; gravity: 36° A.P.I.

SILVESTRE—
Producing wells: four flowing; producing depth: 9,763 ft.; estimated daily average production: 100 bbl.; producing formation: Eocene; gravity: 24° A.P.I.

TIA JUANA—
Discovered: 1928; producing wells: 151 flowing, 527 pumping; producing depth: 3,001 ft.; estimated daily average production: 162,041 bbl.; accumulative production to July 1, 1950: 628,901,154 bbl.; wells drilling: three; producing formation: Miocene, Oligocene; gravity: 13° A.P.I.

TOTUMO—
Discovered: 1914; producing depth: 1,550-3,100 ft.; accumulative production to July 1, 1950: 150,000 bbl.; producing formation: Miocene, Oligocene; gravity: 33° A.P.I.

*Includes Bachaquero, Cabimas, Lagunillas, Tia Juana.

YUGOSLAVIA*

PEKLENCO-SELENCIA—
Discovered: 1942; producing depth: 4,000-4,200 ft.

*U.S.S.R. controlled, no current data available.

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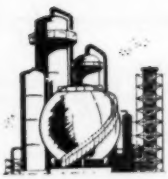
THE JOURNAL'S  WORLD-WIDE

SURVEY OF OIL REFINERIES

Summary of World Refining Capacity

Countries—	No. of operating refineries	Barrels per day—Crude oil capacity	Barrels per day—Cracking capacity
Argentina	17	151,700	89,560
Australia	5	19,300	1,600
Bahrein Island	1	155,000	51,500
Belgium	7	14,300	3,500
Bolivia	3	7,200	.....
Brazil	3	6,500	2,500
Canada	29	339,700	179,900
Canary Islands	1	19,000	5,000
Colombia	2	23,840	.....
Cuba	6	7,300	1,100
Denmark	3	620	.....
East Indies	6	205,500	56,000
Ecuador	2	4,400	.....
Egypt	2	41,000	6,400
England	17	145,750	29,000
Eire	1	600	.....
France	16	363,100	49,650
Germany	30	111,900	15,770
India	1	5,750	1,500
Iran	1	500,000	130,000
Iraq	2	9,500	.....
Israel	1	100,000	20,000
Italy	14	102,500	28,100
Japan	12	47,540	5,500
Kuwait	1	25,000	.....
Lebanon	1	10,000	.....
Mexico	7	160,350	25,900
Netherlands	2	97,900	33,400
Norway	1	1,000	.....
Pakistan	1	4,800	2,000
Peru	3	35,100	6,600
Portugal	1	7,500	.....
Saudi Arabia	1	140,000	20,000
Scotland	4	45,700	4,300
Spain	2	5,700	9,000
Sweden	4	24,800	5,200
Switzerland	1	2,000	.....
Trieste	2	12,500	.....
Turkey	1	1,400	.....
Uruguay	1	25,200	2,000
Venezuela	16	284,770	57,000
Wales	1	60,000	4,000
West Indies	9	724,300	376,000
Total outside of U. S. excl. U.S.S.R. and its satellites	241	4,050,020	1,221,980
Total United States	364	6,540,265	3,707,905
Total world excl. U.S.S.R. and satellites	604	10,590,285	4,929,885

ARGENTINA

Operating refineries	17
Crude-oil-capacity rating, bbl. per day	151,700
Cracking-capacity rating, bbl. per day	89,560

"Astra" Cia. Argentina de Petroleo, S. A., Alem 621 (R.I.), Buenos Aires—
Refinery: Comodoro Rivadavia. Daily crude-oil capacity, 2,500 bbl.; type, distillation.

Cia. General Asfaltos, Buenos Aires—
Refinery: Wilde, Buenos Aires. Daily crude-oil capacity, 500 bbl.; type, distillation, lube oil.

Cia. Nativa de Petroleos, S. A., Av. Pte. R. Saenz—
Refineries: Campana. Daily crude-oil capacity, 16,000 bbl.; daily cracking capacity, 8,800 bbl.; type, complete.

Puerto Galvan. Daily crude-oil capacity, 5,000 bbl.; daily cracking capacity, 2,200 bbl.; type, distillation, asphalt.

Cia. La Isaura, S. A., Ave. Pte. R. S., Pena 699, Buenos Aires—
Refinery: Bahia Blanca. Daily crude-oil capacity, 2,200 bbl.; daily cracking capacity, 350 bbl.; type, distillation, cracking.

Cia. Condor, Levalle 27, Avellaneda—
Refinery: Avellaneda. Daily crude-oil capacity, 1,300 bbl.; type, distillation, lube-oil.

Diadema Argentina, S. A., de Petroleo, Roque 788 Saenz Pena, Buenos Aires—
Refinery: Buenos Aires. Daily crude-oil capacity, 15,000 bbl.; daily cracking capacity, 9,000 bbl.; type, distillation, cracking.

Lottero-Papinia y Cia., Avellaneda—
Refinery: Avellaneda. Daily crude-oil capacity, 300 bbl.; type, distillation, lube-oil.

Standard Oil Co., S. A., Argentina Ave. R. Saenz Pena 567, Buenos Aires—
Refineries: Manuel Elordi. Daily crude-oil capacity, 1,100 bbl.; type, distillation.

Dadin. Daily crude-oil capacity, 400 bbl.; type, distillation.

Ultramar, S. A., Petrolera Argentina, Ave. Alem 619, Buenos Aires—
Refinery: Avellaneda. Daily crude-oil capacity, 6,000 bbl; daily cracking capacity, 1,200 bbl.; type, complete.

Yacimiento Petroliferos Fiscales, Ave. Roque Saenz, Pena 777, Buenos Aires—
Refineries: Buenos Aires. Daily crude-oil capacity, 2,800 bbl.; type, distillation.

Comodoro Rivadavia. Daily crude-oil capacity, 8,000 bbl.; daily cracking capacity, 5,800 bbl.; type, distillation, cracking.

La Plata. Daily crude-oil capacity, 55,000 bbl.; daily cracking capacity, 57,000 bbl.; type, complete.

Mendoza, Prov. Daily crude-oil capacity, 9,000 bbl.; daily cracking capacity, 2,760 bbl.; type, distillation, cracking.

Plaza Huincul. Daily crude-oil capacity, 1,600 bbl.; daily cracking capacity, 250 bbl.; type, distillation, cracking.

San Lorenzo. Daily crude-oil capacity, 25,000 bbl.; daily cracking capacity, 2,200 bbl.; type, distillation, cracking.

AUSTRALIA

Operating refineries	5
Crude-oil-capacity rating, bbl. per day	19,300
Cracking-capacity rating, bbl. per day	1,600
Refineries under construction	1

Australian Shell Oil Co., Melbourne—
Refinery: Geelong (under construction). Type, distillation. (Plans call for completing this new refinery in 1951.)

Bitumen and Oil Refineries (Australia), Ltd., 115 Pitt St., Sydney—
Refinery: Matraville. Daily crude-oil capacity, 6,000 bbl.; type, distillation, asphalt.

Commonwealth Oil Refineries, Ltd., Scottish House, 90 William St., Melbourne—
Refinery: Laverton. Daily crude-oil capacity, 2,500 bbl.; type, distillation.

National Oil Proprietary, Ltd., Glen Davis 6 W, New South Wales—
Refinery: Glen Davis. Daily shale-oil ca-

pacity, 1,500 bbl.; daily cracking capacity, 1,600 bbl.; type, distillation, cracking.

The Shell Co. of Australia, Ltd., Shell Corner, 163 Williams St., Melbourne—
Refinery: Clyde. Daily crude-oil capacity, 8,100 bbl; type, distillation, asphalt. (Includes 900 bbl. per day topped crude-oil capacity.)

Vacuum Oil Pty., Ltd., 29 Market St., Melbourne—
Refinery: Altona. Daily crude-oil capacity, 1,200 bbl.; type, distillation, asphalt, lube-oil.

BAHREIN ISLAND

Bahrein Petroleum Co., Ltd., 551 Fifth Ave., N. Y. 17, U.S.A.—
Refinery: Bahrein, Persian Gulf. Daily crude-oil capacity, 155,000 bbl.; daily cracking capacity, 51,500 bbl.; type, distillation, cracking, asphalt. (15,000 bbl. daily thermal cracking capacity, 17,000 bbl. daily fluid catalytic cracking capacity, and 19,500 bbl. per day, thermal reforming capacity).

BELGIUM

Operating refineries	7
Crude-oil-capacity rating, bbl. per day	14,300
Cracking-capacity rating, bbl. per day	3,500
Refineries under construction	1
Refineries planned	1

"Albatros," Ste. Belge pour le Raffinage de Petrole, 10 Petroleumkaai, Antwerp-Kiel—
Refinery: Antwerp-Kiel. Daily crude-oil capacity, 3,300 bbl.; type, distillation.

Belgian Shell Co., 47 Canterstun, Brussels—
Refinery: Ghent. Daily imported topped crude-oil capacity, 1,800 bbl.; type, distillation, lube-oil, wax.

Cie. Industrielle Atlas, Hoboken-Antwerp—
Refinery: Hoboken-Antwerp (planned for 1953 completion). Daily crude-oil capacity, 25,000 bbl; type, distillation.

Esso Standard (Belgium) S.A., 101 Ave. de France, Antwerp—
Refinery: Antwerp. Daily crude-oil capacity, 1,500 bbl.; type, distillation.

Raffinerie Belge de Petroles, 116 Avenue de France—
Refinery: Antwerp. Daily crude-oil capacity, 6,000 bbl.; daily cracking capacity, 3,500 bbl.; type, distillation, cracking.

Raffinerie et Distilleries Anversoises, Antwerp—
Refinery: Antwerp. Daily crude-oil capacity, 2,000 bbl.; type, distillation.

Redventza S.A. Belge Pour le Raffinage de Petrole, 10 Petroleumkaai, Anvers-Kiel—
Refinery: Antwerp-Kiel. Daily crude capacity, 300 bbl.; type, distillation.

Ste. Industrielle Belge des Petroles, S.A., 111 Rue du Commerce, Brussels—
Refinery: Antwerp (under construction). Daily crude capacity, 27,000 bbl.; daily cracking capacity, 15,000 bbl.; type, distillation, cracking. (New refinery, to be completed by end of 1951.)

Tankage et Transport, S.A., 10 Palace Leopold, Antwerp—
Refinery: Antwerp-Kiel. Daily crude capacity, 1,200 bbl.; type, distillation.

BOLIVIA

Operating refineries	3
Crude-oil-capacity rating, bbl. per day	7,200
Expansion projects under way	1

Yacimientos Petroliferos Fiscales Bolivianos, Avs. Gral. Camacho y Bueno—
Refineries: Camiri. Daily crude capacity, 1,200 bbl.; type, distillation.
Cochabamba. Daily crude capacity, 5,000 bbl.; type, distillation.
Sucre. Daily crude capacity, 1,000 bbl.; type, distillation. (Additional 3,000 bbl. daily crude-oil capacity contracted for completion in 1951.)

BRAZIL

Operating refineries	3
Crude-oil-capacity rating, bbl. per day	6,500
Cracking-capacity rating, bbl. per day	2,500
Refineries under construction	1
Refineries planned	3

Conselho Nacional do Petroleo, Av. Presidente Wilson, 164 Rio de Janeiro—
Refineries: Capuava (planned).
Cubatao, Sao Paulo (under construction). Daily crude capacity, 45,000 bbl.; daily cracking capacity, 46,000 bbl.; type, distillation, cracking. (Scheduled for 1952 completion.)
Mataripe, Bahia. Daily crude capacity, 2,500 bbl.; daily cracking capacity, 2,500 bbl.; type, distillation, cracking.
Rio de Janeiro (planned).
Santos (planned).

Industrias Matarazzo de Energia, S.A., Predio, Conde Matarazzo—
Refinery: Sao Paulo. Daily crude capacity, 1,000 bbl.; type, distillation, wax.

Ipiranga S.A. Cia. Brasileira de Petroleos, Saco de Mangueira se numbro, Rio Grande—
Refinery: Rio Grande. Daily crude capacity, 3,000 bbl.; type, distillation.

BURMA

All three refineries in Burma were demolished to destroy their usefulness in event of capture by the enemy in World War II. The refineries were located near Rangoon.

CANADA

Operating refineries	29
Crude-oil-capacity rating, bbl. per day	339,700
Cracking-capacity rating, bbl. per day	179,900
Expansion projects planned	3
Expansion projects under way	5
New refinery projects planned	1
New refinery projects under way	3

A detailed listing of Canadian refineries was published in The Oil and Gas Journal's Annual Refining Issue, March 23, 1950.

CANARY ISLANDS (Spain)

Operating refineries	1
Crude-oil-capacity rating, bbl. per day	19,000
Cracking-capacity rating, bbl. per day	5,000
Expansion projects planned	1

Cia. Espanola de Petroleos, S.A., Alcala, 31, Madrid—
Refinery: Sta. Cruz de Tenerife. Daily crude capacity, 19,000 bbl.; daily cracking capacity, 5,000 bbl.; type, complete. (L.P.G. production to start in early 1951. A 6,000-bbl.-per-day reforming unit is planned for the near future.)

CHILE

Operating refineries	None
Refinery projects planned	1

Corporacion de Fomento, Ramon Nietro 920, Santiago—
Refinery: Santiago (new refinery planned). Daily crude-oil capacity, 15,000 bbl. (Completion scheduled for 1952-53.)

CHINA

Because of the unsettled political situation in China, reliable reports on its current refining industry are not available.

COLOMBIA

Operating refineries	2
Crude-oil-capacity rating, bbl. per day	23,840

Colombian Petroleum Co., Cucuta—
Refinery: Petrolea. Daily crude-oil capacity, 840 bbl.; type, distillation.

Tropical Oil Co., El Centro—
Refinery: Barranca-Bermeja. Daily crude-oil capacity, 23,000 bbl.; type, distillation, asphalt, lube-oil.

CUBA

Operating refineries	6
Crude-oil-capacity rating, bbl. per day	7,300
Cracking-capacity rating, bbl. per day	1,100

Cia. Exploradora de Petroles—
Refinery: Jarahueca. Daily crude-oil capacity, 400 bbl.; type, distillation.

Cia. Petrolera Jarahueca—
Refinery: Jarahueca. Daily crude-oil capacity, 600 bbl.; type, distillation.

Cuban Oil Refining Co.—
Refinery: Cabaiquan. Daily crude-oil capacity, 800 bbl.; type, distillation.

Destiladora Jarahueca—
Refinery: Santa Clara. Daily crude-oil capacity, 200 bbl.; type, distillation.

Esso Standard Oil Co. (Cuba), Havana—
Refinery: Belot. Daily crude-oil capacity, 5,000 bbl.; daily cracking capacity, 1,100 bbl.; type, complete.

Union Gas Co.—
Refinery: Bacuranao. Daily crude-oil capacity, 300 bbl.; type, distillation.

DENMARK

Operating refineries	3
Crude-oil-capacity rating, bbl. per day	620

Dansk Mineraloliefabrik, Copenhagen—
Refinery: Copenhagen. Daily crude-oil capacity, 50 bbl.; type, distillation, lube-oil.

Det. Danske Pet. Aktieselskab, Sankt Annae Plads 13, Copenhagen—
Refinery: Klundborg. Daily crude-oil capacity, 500 bbl.; type, distillation, asphalt.

L. C. Glad Co., A. S., Copenhagen—
Refinery: Copenhagen. Daily crude-oil capacity, 70 bbl.; type, distillation.

EAST INDIES

Borneo:	
Operating refineries	1
Crude-oil-capacity rating, bbl. per day	27,000
Java:	
Operating refineries	1
Crude-oil-capacity rating, bbl. per day	2,000
Inoperative refineries	1
Sumatra:	
Operating refineries	3
Crude-oil-capacity rating, bbl. per day	138,500
Cracking capacity rating, bbl. per day	56,000
Inoperative refineries	1
Sarawak:	
Operating refineries	1
Crude-oil-capacity rating, bbl. per day	38,000

N. V. de Bataafsche Petroleum Mij., Carl van Byjlantlaan 30, The Hague, Netherlands—

Refineries: Balik Papan, Borneo. Daily crude-oil capacity, 27,000 bbl.; type, distillation.

Tjepoe, Java. (Not operating due to damage under political disturbances. Part of refinery to be rehabilitated.)

Wonokromo, Java. Daily crude-oil capacity, 2,000 bbl.; type, distillation, asphalt.

Pangkalan Brandan, Sumatra. (Refinery currently inaccessible.)

Pladju, Sumatra. Daily crude-oil capacity, 74,000 bbl.; daily cracking capacity, 25,000 bbl.; type, distillation, cracking.

Sarawak Oilfields, Ltd., Miri, Sarawak—

Refinery: Lutong, Sarawak. Daily crude-oil capacity, 38,000 bbl.; type, distillation.

Standard-Vacuum Petroleum Mij.—

Refineries: Sungei, Gerong, Sumatra. Daily crude-oil capacity, 64,000 bbl.; daily cracking capacity, 31,000 bbl.; type, distillation, cracking, wax.

Kappan, Sumatra. Daily crude-oil capacity, 500 bbl.; type, distillation.

ECUADOR

Operating refineries 2
Crude-oil-capacity rating, bbl. per day 4,400

Anglo-Ecuadorian Oilfields, Ltd., 145 Dashwood House, Old Broad St., London, E. C. 2—

Refinery: La Libertad. Daily crude-oil capacity, 4,000 bbl.; type, distillation.

Ecuador Oilfields, Ltd., Apt. 865, Guayaquil—

Refinery: Cautivo. Daily crude-oil capacity, 400 bbl.; type, distillation.

EGYPT

Operating refineries 2
Crude-oil-capacity rating, bbl. per day 41,000
Cracking-capacity rating, bbl. per day 6,400
Expansion projects planned .. 1

Anglo-Egyptian Oilfields, Ltd., Great Street, St. Helens Court, London, E. C. 3—

Refinery: Suez. Daily crude-oil capacity, 38,000 bbl.; daily cracking capacity, 6,400 bbl.; type, distillation, cracking, asphalt.

Raffinerie de Petrole du Government, 18 Rue Fouad Ier, Alexandria—

Refinery: Suez. Daily crude-oil capacity, 3,000 bbl.; type, distillation. (Construction is under way to increase refinery capacity.)

ENGLAND

Operating refineries 17
Crude-oil-capacity rating, bbl. per day 145,750
Cracking-capacity rating, bbl. per day 29,000
New refinery projects 1
Expansion projects under way 3

Anglo-American Oil Co., Ltd., 36 Queen Anne's Gate, London, S. W. 1.—

Refinery: Fawley, Southampton. Daily crude-oil capacity, 23,500 bbl.; daily cracking capacity, 6,000; type, complete. (Expansion to 110,000 bbl. per day under way. Anglo-American Oil Co., Ltd., is also building a 33,000-bbl. per day catalytic cracking unit.)

Anglo-Iranian Oil Co., Ltd., Britannic House, Finsbury Circus, London, E. C. 2—

Refinery: Isle of Grain, Kent (under construction). Daily crude-oil capacity, 40,000 bbl.; type, distillation. (Completion scheduled for 1952.)

Berry, Wiggins & Co., Ltd., Field House Breams Buildings, Fetter Lane, London, E. C. 4—

Refineries: Hoo, North Rochester. Daily crude capacity, 2,000 bbl.; type, distillation.

Weaste, Salford. Daily crude capacity, 1,500 bbl.; type, distillation.

British Bitumen Refinery, Thames-Haven—

Refinery: Thames-Haven. Daily crude-oil capacity, 1,000 bbl.; type, distillation.

Imperial Chemical Industries, Ltd., 2 Buckingham Gate, London, S. W. 1.—

Refinery: Wilton, North Yorkshire. Daily cracking capacity, 6,000 bbl.; type, petrochemical.

Lobitos Oilfields, Ltd., 146 Dashwood House, Old Broad St., London, E. C. 2—

Refinery: Ellsmere Port, Cheshire. Daily crude-oil capacity, 2,500 bbl.; daily cracking capacity, 1,000 bbl.; type, complete. (Refinery expansion under way.)

London & Coastal Oil Wharves, Ltd., 3 St. Helen's Place, London, E. C. 2—

Refinery: Canvey Island. Daily crude-oil capacity, 1,500 bbl.; type, distillation.

London & Thames Haven Oil Wharves, Ltd., 3 St. Helen's Place, London, E. C. 3—

Refinery: Thames Haven. Daily crude-oil capacity, 10,000 bbl.; type, distillation.

London Major & Co., Ltd., Hull—

Refinery: Hull. Daily crude-oil capacity, 1,250 bbl.; type, distillation.

Manchester Oil Refinery, Ltd., Twining Road, Trafford Park, Manchester, 17—

Refinery: Trafford Park, Manchester. Daily crude capacity, 2,800 bbl.; type, distillation, lube-oils, special products.

Petrochemicals, Ltd., Partington Industrial Estate, Urmston, Manchester—

Refinery: Urmston, Manchester. Daily cracking capacity, 2,000 bbl.; type, petrochemicals. (Charging stock for this plant is a petroleum distillate. Processing facilities consist of catalytic cracking, low-temperature gas separation, atmospheric, vacuum, azeotropic and rerun distillation. Products are olefinic and aromatic chemicals.)

Shell Refining & Marketing Co., Ltd.—

Refinery: Heysham. Daily crude-oil capacity, 37,500 bbl.; daily cracking capacity, 3,500 bbl.; type, distillation, cracking.

Shell Refining & Marketing Co., Ltd., and Stanhaven Refineries, Ltd., Norman House, 105-109 Strand, London, W. C. 2—

Refinery: Shellhaven. Daily crude capacity, 16,600 bbl.; type, distillation. (Shell operates a petrochemical plant at Stanlow for manufacture of various chemical products of petroleum origin. Associated with the petrochemical plant at the Shellhaven and Stanlow refineries. The Stanlow plant produces chemical products.)

Stanhaven Refineries, Ltd., and Shell Refining & Marketing Co., Ltd.—

Refinery: Stanlow. Daily crude-oil capacity, 40,700 bbl.; daily cracking capacity, 8,500 bbl.; type, distillation, cracking.

Vacuum Oil Co., Ltd., Caxton House, Tothill Street, London S. W. 1—

Refinery: Coryton, Essex. Daily crude-oil capacity, 4,000 bbl.; daily cracking capacity, 2,000 bbl.; type, distillation, cracking. (Refinery to be increased.)

W. H. Keys, Portishead—

Refineries: Portishead. Daily crude-oil capacity, 500 bbl.; type, distillation.

West Bromwich. Daily crude-oil capacity, 400 bbl.; type, distillation.

EIRE

Operating refineries 1
Crude-oil-capacity rating, bbl. per day 600

Cork Harbour Oil Wharves, Ltd., 146 Dashwood House, Old Broad St., London, E. C. 2—

Refinery: Haulbowline Is. Daily crude capacity, 600 bbl.; type, distillation.

FRANCE

Operating refineries 16
Crude-oil-capacity rating, bbl. per day 363,100
Cracking-capacity rating, bbl. per day 49,650
Expansion projects under way 2

Cie. Francaise de Raffinage, 11 Rue du Docteur Lanceraux, Paris 8—

Refineries: Gonfreville-l-Orcher. Daily crude-oil capacity, 50,000 bbl.; daily cracking capacity, 7,400 bbl.; type, distillation, cracking, wax.

La Mede. Daily crude-oil capacity, 44,000 bbl.; daily cracking capacity, 3,700 bbl.; type, distillation, cracking, wax.

Cie. Industrielle des Petroles, 54 Rue de Londres, Paris 9—

Refinery: Frontigan, Herault; Daily crude-oil capacity, 9,000 bbl.; type, distillation.

Cie. de Raffinage Shell-Berre, 29 Rue de Berri, Paris 8—

Refineries: Berre. Daily crude-oil capacity, 25,000 bbl.; daily cracking capacity, 7,500 bbl.; type, complete.

Petit-Couronne. Daily crude-oil capacity, 48,500 bbl.; daily cracking capacity, 3,250 bbl.; type, distillation, cracking, lube-oil, wax.

Pauillac. Daily crude-oil capacity, 4,300 bbl.; type, distillation, asphalt.

Les Propetrol Consommateurs de Petrole—

Refinery: Brest. Daily crude-oil capacity, 10,300 bbl.; type, distillation.

Pechelbronn S. A., d'Explorations Minieres, 32 Allee de la Robert Sau, Strasburg—

Refinery: Merckwiller. Daily crude-oil capacity, 1,500 bbl.; type, distillation, lube-oil, asphalt.

Raffineries Francaises des Petroles de Atlantique, Donges, St. Nazaire—

Refinery: Donges. Daily crude-oil capacity, 16,000 bbl.; type, distillation, lube oil.

Ste. de Raffinage des Huiles de Petrole, 19-21 Rue de la Bienfaisance, Paris, 8—

Refinery: L'Avera. Daily crude-oil capacity, 36,000 bbl.; daily cracking capacity, 7,300 bbl.; type, distillation, cracking.

Ste. des Raffineries de Petrole de la Gironde, 7 Place Vendome, Paris—

Refinery: Ambes. Daily crude-oil capacity, 13,000 bbl.; daily cracking capacity, 3,000 bbl.; type, distillation, cracking.

Ste. Generale des Huiles de Petrole, 19-21 Rue de la Bienfaisance, Paris 8—

Refineries: L'Avera. Daily crude-oil capacity, 30,000 bbl.; type, distillation.

Dunkerque. Daily crude-oil capacity, 7,000 bbl.; daily cracking capacity, 7,300 bbl.; type, distillation, cracking. (Capacity to be increased to 30,000 bbl. daily crude-oil input in early 1952.)

Socony-Vacuum Francaise, 46 Rue de Courcelles, Paris 8(eme)—

Refineries: Notre Dame de Gravenchon. Daily crude-oil capacity, 12,500 bbl.; daily cracking capacity, 1,900 bbl.; type, distillation, cracking, lube oil.

Frontignan. Daily crude-oil capacity, 20,000 bbl.; daily cracking capacity, 2,500 bbl.; type, distillation, cracking.

Standard Francaise des Petroles, 82 Champs Elysees, Paris 8—

Refineries: Notre Dame de Gravenchon. Daily crude-oil capacity, 36,000 bbl.; daily cracking capacity, 5,800 bbl.; type, complete. (10,000-bbl. daily catalytic cracking unit to be put into operation 1952-1953).

GERMANY

Operating refineries 30
Crude-oil-capacity rating, bbl. per day 111,900
Cracking-capacity rating, bbl. per day 15,770
Refinery rebuilding projects .. 1

AMERICAN ZONE OF OCCUPATION

Gresheim Elektron, Gresheim near Frankfort—

Refinery: Gresheim. Daily capacity, 700 bbl.; type, gasoline rerun.

Zeller and Gmelin, Eislingen (Wuerttenberg)—
Refinery: Eislingen. Daily crude capacity, 150 bbl.; type, distillation.

BRITISH ZONE OF OCCUPATION

BP Benzin und Petroleum, GmbH, Hamburg—
Refinery: Hamburg-Finkenwerder. Daily crude-oil capacity, 11,500 bbl.; type, distillation.

Coelner Benzin Raffinerie, GmbH, Cologne—
Refinery: Cologne. Daily capacity, 300 bbl.; type, gasoline rerun.

Deutsch-Amerikanische Petroleum-Gesellschaft, Hamburg—
Refinery: Hamburg-Harburg. Daily crude-oil capacity, 12,500 bbl.; type, distillation, asphalt.

Deutsche Erdoel, A. G., Wietze, Kries Celle, Niedersachsen—
Refineries: Heide (Holstein). Daily crude-oil capacity, 1,500 bbl.; type, distillation, lube oil, asphalt.
Wietze (Hanover). Daily crude-oil capacity, 950 bbl.; type, distillation, lube oil, asphalt.

Deutsche Gasolin, A. G., Hannover, Jordanstr. 32—
Refinery: Dollberge (Hannover). Daily crude capacity, 1,800 bbl.; type, distillation, lube oil, asphalt.

Deutsche Shell, A. G., Shell Haus, Hamburg 36, Alster Ufer 45—
Refineries: Harburg. Daily crude capacity, 10,000 bbl.; type, complete.
Manheim. Daily crude-oil capacity, 3,500 bbl.; type, distillation, lube oil.
Grasbrook. Daily capacity, 550 bbl; type, lube oil.
Reisholz. Daily capacity, 750 bbl.; type, special distillation.
Wilhelmsburg. Daily capacity, 450 bbl.; type, special distillation.

Deutsche Vacuum Oel, A. G., Bartholomay-Haus, Steinstrasse, 5/7 (24a) Hamburg—
Refineries: Bremen. Daily crude-oil capacity, 14,000 bbl.; type, distillation, lube oil, wax.
Wedel on Elbe. Daily crude-oil capacity, 700 bbl.; type, lube oil.

Ebano-Asphalt-Werke, A. G., Neuer Jungfernsteig 21, Hamburg—
Refinery: Hamburg. Daily crude-oil capacity, 10,000 bbl.; type, distillation, lube oil, wax.

Ernst Schliemann's Oelwerke, Hamburg, 1, Spitalerstr—
Refinery: Grasbrook. Daily capacity, 750 bbl.; type, lube oil.

Gelsenberg Benzin AG Gelsenkirchen—
Refinery: Gelsenkirchen. Daily crude-oil capacity, 15,000 bbl.; daily cracking capacity, 7,000 bbl.; type, distillation, cracking. (The capacity listed under cracking for this refinery is that of a hydrogenation unit.)

Georg Greiser, Dollbergen—
Refinery: Dollbergen (Hanover). Daily capacity, 75 bbl.; type, lubricating oil.

Gewerkschaft Deurag-Nerag, Hannover, Hindenburgstr, 27-29—
Refinery: Misburg (Hannover). Daily crude-oil capacity, 9,200 bbl.; daily cracking capacity, 3,500 bbl.; type, complete.

Johann Haltermann, Hamburg 1, Ferdinandstr, 55, 57—
Refinery: Wilhelmsburg. Daily crude-oil capacity, 1,200 bbl.; type, distillation.

Mineraloelwerke Albert Sengewald, Dedenhausen, Hannover—
Refinery: Dedenhausen, Hannover. Daily capacity, 470 bbl.; type, lube oil.

Mineraloel and Asphaltwerke, A. G., Hamburg 1, Ferdinandstr, 29, 31—
Refinery: Ostermoor-Holstein. Daily crude-oil capacity, 1,150 bbl.; type, distillation.

Mineraloelwerke Albrecht & Co., Hamburg, 1, Glokengiesserwall 2—
Refinery: Gasbrook. Daily capacity, 250 bbl.; type, lube oil.

Mineraloelwerk Grasbrook, Hamburg, 1, Alsterdamm 16, 18—
Refinery: Hamburg-Grasbrook. Daily capacity, 250 bbl.; type, lube oil.

Mineraloelwerke Peine, Hannover—
Refinery: Peine, Hannover. Daily crude-oil capacity, 350 bbl.; type, distillation, lube oil.

Oelwerke Julius Schindler, Hamburg 36, Hohe Bleichen 28—
Refinery: Wilhelmsburg. Daily crude-oil capacity, 2,300 bbl.; type, distillation, lube oil.

Olex D.B.P.G. Tanklager, Steinstrasse 5, Hamburg 1—
Refinery: Hamburg. Daily crude-oil capacity, 12,500 bbl.; daily cracking capacity, 4,850 bbl.; type, distillation, cracking.

Wintershall, A. G., Celle, Stoerckenstrasse—
Refinery: Salzbergen. Daily crude-oil capacity, 1,400 bbl.; daily cracking capacity, 420 bbl.; type, complete.

FRENCH ZONE OF OCCUPATION

Badische Anilin and Soda-Fabrik, Ludwigshafen—
Refinery: Ludwigshafen (rebuilding). Daily crude-oil capacity, 5,000 bbl.; daily cracking capacity, 2,400 bbl.; type, complete.

U.S.S.R. ZONE OF OCCUPATION

Mineraloelwerke Peine, Peine, Hannover—gung, Volkseigener Betriebe (Z) Kohlenwerkstoffe, Luitzkendorf near Merseburg, Saxonia—
Refinery: Luetzkendorf. Daily crude-oil capacity, 2,200 bbl.; type, distillation, lube oil, wax, asphalt.

HAWAIIAN ISLANDS

Pacific Refiners, Ltd., Honolulu—
Refinery: Honolulu (under construction). Daily capacity, 3,000 bbl.; type, asphalt. (This refinery is to operate on a mixture of heavy or reduced crude oil and butane which is to be imported.)

HUNGARY

Data on current status of Hungarian refining industry not available.

INDIA

Assam Oil Co., Ltd., Britannic House, Finsbury Circus, London, England—
Refinery: Digboi, Assam. Daily crude capacity, 5,750 bbl.; daily cracking capacity, 1,500 bbl.; type, complete.

IRAN

Anglo-Iranian Oil Co., Ltd., Britannic House, Finsbury Circus, London, E. C. 2—
Refinery: Abadan. Daily crude-oil capacity, 500,000 bbl.; daily cracking capacity, 130,000 bbl.; type, complete. (Includes 30,000-bbl.-daily catalytic cracking facilities being constructed. A 400-bbl. per day lubricating-oil plant is also under construction.)

IRAQ

Operating refineries	2
Crude-oil-capacity rating, bbl. per day	9,500

Iraq Petroleum Co., Ltd., City Gate House, Finsbury Circus, London, E. C. 2—
Refinery: Baba Gurgur. Daily crude-oil capacity, 1,500 bbl.; type, distillation.

Khanaqin Oil Co., Ltd., Britannic House, Finsbury Circus, London, E. C. 2—
Refinery: Alwand. Daily crude capacity, 8,000 bbl.; type, distillation.

ISRAEL

Consolidated Refineries, Ltd., Britannic House, Finsbury Circus, London E. C. 2—
Refinery: Haifa. Daily crude capacity, 100,000 bbl.; daily cracking capacity, 20,000 bbl.; type, distillation, cracking.

ITALY

Operating refineries	14
Crude-oil-capacity rating, bbl. per day	102,500
Cracking capacity rating, bbl. per day	28,100
New refineries under way	1
Expansion projects under way	1

Azienda Nazionale Idrogenazione Combustibili, Milano via Albania, 20—
Refineries: Bari. Daily crude-oil capacity, 15,000 bbl.; daily cracking capacity, 8,000 bbl.; type, distillation, cracking, asphalt.
Livorno. Daily crude-oil capacity, 5,000 bbl.; daily cracking capacity, 2,000 bbl.; type, distillation, cracking, asphalt.

Distillazione Italiana Combustibili, Soc. An., Venice—
Refinery: Porto Marghera. Daily crude-oil capacity, 5,600 bbl.; daily cracking capacity, 3,500 bbl.; type, distillation, cracking.

Industrie Chimiche Italian del Petrolio, Manta—
Refinery: Manta (under construction). Daily crude-oil capacity, 600 bbl.; type, distillation.

Industrial Raffinazione Oli Minerali, Via Castella Postale 479, Venice—
Refinery: Porto Marghera. Daily crude capacity, 12,000 bbl.; daily cracking capacity, 8,000 bbl.; type, distillation, cracking. (New 12,000-bbl. daily vacuum distillation unit to be in operation by early 1952. Additional reforming equipment to be installed by early 1953.)

Lombarda Petroli—
Refinery: Villasanta. Daily crude capacity, 800 bbl.; type, distillation.

Permolio—
Refineries: Milan. Daily crude capacity, 1,200 bbl.; type, distillation.
Genoa. Daily crude capacity, 1,200 bbl.; type, distillation.
Fiorenzuola d'Arda. Daily crude capacity, 500 bbl.; type, distillation.
Rowe. Daily crude capacity, 1,000 bbl.; type, distillation.

Petroli d'Italia—
Refinery: Fiorenzuola d'Arda. Daily crude capacity, 300 bbl.; type, distillation.

Socony-Vacuum Italiana, S.P.A., 26 Broadway, New York, 4, N. Y.—
Refinery: Naples. Daily crude capacity, 33,000 bbl.; daily cracking capacity, 5,000 bbl.; type, complete.

Raffinerie Siciliane Oli Minerali, S. A. Augusta, Sicily—
Megara. Daily crude-oil capacity, 11,000 bbl.; type, distillation.

Soc. per l'Industria Italiana del Petrolio, Plaza del la Vittoria, Genoa—
Refinery: Spezia. Daily crude-oil capacity, 15,000 bbl.; daily cracking capacity, 1,600 bbl.; type, distillation, cracking, asphalt.

Soc. Petrolifera Italiana, Fornovo-Taro—
Refinery: Fornovo. Daily crude capacity, 400 bbl.; type, distillation.

JAPAN

Operating refineries	12
Crude-oil-capacity rating, bbl. per day	47,540
Cracking-capacity rating, bbl. per day	5,500
Rehabilitation projects planned	1
Refineries not operating	1

Maruzen Oil Co., Ltd., No. 2 Mita-Shikoku-Machi, Shiba, Minato-Ku, Tokio—
Refineries: Ehime-Ken. Daily crude-oil capacity, 2,000 bbl.; type, distillation. (Operations pending SCAP approval.)
Wakayama-Ken. Daily crude-oil capacity, 9,000 bbl.; type, distillation.

Mitsubishi Oil Co., Ltd., No. 82 Chome, Marunochi, Chiyoda-Ku, Tokio—
Refinery: Kanagawa-Ken. Daily crude-oil capacity, 4,500 bbl.; type, distillation.

Nippon Oil Co., Ltd., 3-10 Chome, Marunochi, Chiyoda-Ku, Tokio—
Refineries: Akita. Daily crude-oil capacity, 4,230 bbl.; type. distillation, lube oil, asphalt.
Hokkaido. Daily crude-oil capacity, 250 bbl.; type, distillation.
Kashiwazaki. Daily crude-oil capacity, 1,260 bbl.; type, distillation, lube oil, wax, asphalt.
Kudamatsu. Daily crude-oil capacity, 6,000 bbl.; type, distillation, lube oil, wax, asphalt.
Niigata. Daily crude-oil capacity, 1,800 bbl.; type, distillation, lube oil, wax, asphalt.
Yokohama. Daily crude-oil capacity, 6,000 bbl.; daily cracking capacity, 2,000 bbl.; type, complete.

Nippon Kohyo—
Refinery: Funkawa. Daily crude-oil capacity, 3,000 bbl.

Showa Oil Co.—
Refineries: Hirasawa. Daily crude-oil capacity, 750 bbl.
Niigata. Daily crude-oil capacity, 750 bbl.

Tao Nenryo Kogyo K. K., Tokio—
Refineries: Okaga.
Shimizu (scheduled for rehabilitation). Daily crude-oil capacity, 5,000 bbl.; type, distillation, asphalt. (Cracking unit and other facilities to be installed during 1951.)
Wakayama. Daily crude-oil capacity, 10,000 bbl.; daily cracking capacity, 3,500 bbl.; type, distillation, cracking.

KUWAIT

Kuwait Oil Co., Ltd., 1, Great Cumberland Place, London W1—
Refinery: Kuwait. Daily crude-oil capacity, 25,000 bbl.; type, distillation.

LEBANON

Iraq Petroleum Co., Ltd., P. O. Box 118, Tripoli, Lebanon—
Refinery: Tripoli. Daily crude-oil capacity, 10,000 bbl.; type, distillation.

MEXICO

Operating refineries	7
Crude-oil-capacity rating, bbl. per day	160,350
Cracking-capacity rating, bbl. per day	25,900

A detailed listing of refineries in Mexico was published in the Annual Refining Issue of The Oil and Gas Journal, March 27, 1950.

NETHERLANDS

Operating refineries	2
Crude-oil-capacity rating, bbl. per day	97,900
Cracking-capacity rating, bbl. per day	33,400

Caltex Petroleum Maatschappij, N. V., The Hague—
Refinery: Pernis. Daily crude-oil capacity, 20,000 bbl.; daily cracking capacity, 6,400 bbl.; type, distillation, cracking.

N. V. de Bataafsche Petroleum Mij., Carel van Bylandtlaan 30, The Hague—
Refinery: Pernis. Daily crude-oil capacity, 77,900 bbl.; daily cracking capacity, 27,000 bbl.; type, complete.

NORWAY

A/S Ostlandske Petroleumscompagni, 3A Prinsengate, Olso—
Refinery: Vallo. Daily crude-oil capacity, 1,000 bbl.; type, distillation.

PAKISTAN

Attock Oil Co., Ltd., 24-28 Lombard St., London, E. C. 3—
Refinery: Rawalpindi. Daily crude-oil capacity, 4,800 bbl.; daily cracking capacity, 2,000 bbl.; type, complete.

PERU

Operating refineries	3
Crude-oil-capacity rating, bbl. per day	35,100
Cracking-capacity rating, bbl. per day	6,600

Cia. de Petroleo Ganso Azul, Ltd., Boza 892, Edificio San Martin, 4 Piso, Lima—
Refinery: Agua Caliente. Daily crude-oil capacity, 600 bbl.; type, distillation.

Empresa Petrolera Fiscal—
Refinery: Zorritos. Daily crude-oil capacity, 1,500 bbl.; type, distillation.

International Petroleum Co., Ltd., Talara—
Refinery: Talara. Daily crude capacity, 33,000 bbl.; daily cracking capacity, 6,600 bbl.; type, complete.

POLAND

Information on current status refineries in Poland is not available.

PORTUGAL

"Sacor" S. A. Concessionaria de Refinacao de Petroleos em Portugal, Rua do Alecrim, 57, Lisbon—
Refinery: Cabo Ruivo. Daily crude-oil capacity, 7,500 bbl.; type, distillation, lube oil, asphalt.

ROMANIA

No reliable information is available on the current status of refineries in Romania.

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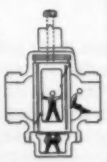

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SAUDI ARABIA

Arabian American Oil Co., Drahran, Saudi Arabia—
Refinery: Ras Tanura. Daily crude-oil capacity, 140,000 bbl.; daily cracking capacity, 28,000 bbl.; type, complete.

SCOTLAND

Operating refineries	4
Crude-oil-capacity rating, bbl. per day	38,900
Cracking-capacity rating, bbl. per day	4,300

Starhaven Refineries, Ltd., Norman House, Strand, London, W. 1—
Refinery: Ardrossan. Daily topped crude-oil capacity, 4,300 bbl.

Scottish Oils, Ltd., 53 Bothwell St., Glasgow, C. 2—
Refineries: Grangemouth. Daily crude-oil capacity, 37,000 bbl.; daily cracking capacity, 3,000 bbl.; type, distillation, cracking.

Pumpherston. Daily capacity, 3,700 bbl.; daily cracking capacity, 1,300 bbl.; type, distillation, cracking, wax. (Distillation operations consist of processing 2,500 bbl. daily of shale oil and 1,200 bbl. per day of United Kingdom crude oil. Refinery at Pumpherston produces synthetic detergents.)

William Briggs & Sons, Ltd., East Camperdown St., Dundee—
Refinery: Dundee. Daily crude-oil capacity, 700 bbl.; type, distillation, lube oil, asphalt.

SOUTH AFRICA

South Africa Torbanite Mining & Refining Co., Ltd., Box 83, Boksburg North, Transvaal—
Refinery: Boksburg North. Daily cracking capacity, 2,000 bbl.; type, shale-oil. (The oil obtained from retorting Torbanite [oil shale] is cracked in a conventional thermal unit.)

SPAIN

Operating refineries	2
Crude-oil-capacity rating, bbl. per day	5,700
Cracking-capacity rating, bbl. per day	9,000
Expansion projects under way	2

Compania Arrendataria del Monoplio de Petroleos, S. A. Torija, 9, Madrid—
Refinery: Cornella, Barcelona. Daily crude-oil capacity, 700 bbl.; type, distillation. (By the middle of 1951 additional facilities, now authorized for construction, will increase crude-oil capacity to 20,000 bbl. daily.)

Refinera de Petroleos de Escomberas, S. A., Carrera de San Jeronimo 19, Madrid—
Refinery: Cartagena. Daily crude-oil capacity, 5,000 bbl.; daily cracking capacity, 9,000 bbl.; type, distillation, cracking. (Crude-oil-distillation unit rated at 25,000 bbl. daily capacity under construction. Completion scheduled for early 1952. Thermal reforming capacity, under construction.)

SWEDEN

Operating refineries	4
Crude-oil-capacity rating, bbl. per day	24,800
Cracking-capacity rating, bbl. per day	5,200

A. Johnson & Co., Postbox 52, Nynashamn—
Refineries: Nynasham. Daily crude-oil capacity, 11,000 bbl.; daily cracking capacity, 1,000 bbl.; type, distillation, cracking, lube oil, asphalt.

Malmo. Daily crude-oil capacity, 1,800 bbl.; type, distillation, asphalt.

Koppartranz Oljeaktiebolag, Box 827, Gothenburg 8—
Refinery: Goteborg. Daily crude-oil capacity, 12,000 bbl.; daily cracking capacity, 4,200 bbl.; type, distillation, cracking.

Svenska, Skifferolje Aktiebolaget, Drottninggatanz, Orebro—
Refinery: Orebro. Daily shale-oil capacity, 1,900 bbl. (capacity increase to 4,000 bbl. daily in 1952.)

SWITZERLAND

Industrie du Pertole S.A., Rotkreuz—
Refinery: Rotkreuz. Daily crude-oil capacity, 2,000 bbl.; type, distillation.

TRIESTE

Operating refineries	2
Crude-oil-capacity rating, bbl. per day	12,500

"Aquila" S. A. Tecnico-Industriale, Trieste—
Refinery: Trieste. Daily crude-oil capacity, 10,000 bbl.; type, distillation, lube oil.

Standard Italo-Americana-Petrolio, 40 Via Assarotti, Genoa, Italy—
Refinery: Trieste. Daily crude-oil capacity, 2,500 bbl.; type, distillation, lube oil, asphalt.

TURKEY

M. T. A. Enstitusu (Turkish Government), Ankara—
Refinery: Batman. Daily crude-oil capacity, 1,400 bbl.; type, distillation.

UNITED STATES

Operating refineries	364
Crude-oil-capacity rating, bbl. per day	6,540,265

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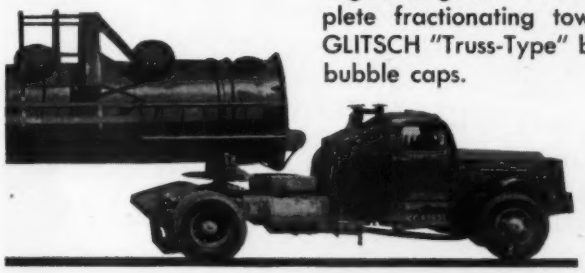

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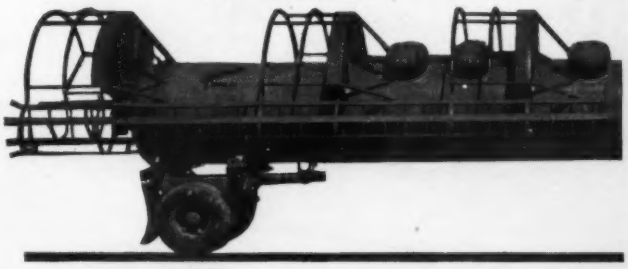

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Cracking-capacity rating, bbl. per day 3,707,905

A detailed listing of United States refineries was published in the Annual Refining Number of The Oil and Gas Journal, March 23, 1950.

U.S.S.R.

Official data on current capacity and status of refining operations in Russia or its satellites are not available.

URUGUAY

Administration Nacional de Combustibles, Alcolhol y Portland, Casilla de Correo 1090, Montevideo—

Refinery: La Teja. Daily crude-oil capacity, 25,200 bbl.; daily cracking capacity, 2,000; type, distillation, cracking. (Capacity includes two topping units and a thermal cracking plant which has been converted to atmospheric distillation operations. When operating the topping units only the refinery crude-oil capacity is approximately 15,800 bbl. daily.

VENEZUELA

Operating refineries 15
Crude-oil-capacity rating, bbl. per day 254,770
Cracking-capacity rating, bbl. per day 57,000

British Controlled Oilfields, Ltd., San F. at Pajaritos No. 15, Caracas—
Refinery: Mene Mauroa. Daily crude-oil capacity, 250 bbl.; type, distillation.

Colon Development Co., Ltd., Mijares a Mercedes 25, Caracas—
Refineries: La Rivera. Daily crude-oil capacity, 200 bbl.; type, distillation.
El Calvario. Daily crude-oil capacity, 200 bbl.; type, distillation.
Casigua. Daily crude-oil capacity, 1,500 bbl.; type, distillation.
La Rivera. Daily crude-oil capacity, 200 bbl.; type, distillation.

Creole Petroleum Corp., 350 Fifth Ave., New York—
Refineries: Amuay. Daily crude capacity, 60,000 bbl.; type, distillation.
Caripito. Daily crude-oil capacity, 58,000 bbl.; daily cracking capacity, 25,000 bbl.; type, distillation, cracking.
La Salina. Daily crude-oil capacity, 10,000 bbl.; type, distillation.

Mene Grande Oil Co., Apartado 709, Caracas—
Refineries: Cabimas. Daily crude-oil capacity, 1,000 bbl.; type, distillation.
Oficina. Daily crude-oil capacity, 300 bbl.; type, distillation.

Shell Caribbean Petroleum Co., Inc., 117 Main St., Flemington, N. J., U.S.A.—
Refinery: San Lorenzo. Daily crude-oil capacity, 38,000 bbl.; type, distillation.

Venezuelan Oil Concessions, Ltd.—
Refinery: Cardon. Daily crude-oil capacity, 40,000 bbl.; daily cracking capacity, 32,000 bbl.; type, distillation, cracking.

Sinclair Oil & Refining Co., Apt., 1708, Caracas—
Refinery: Puerto de la Cruz. Daily crude-oil capacity, 35,000; type, distillation.

Socony-Vacuum Oil Co., Salas a Caja de Agua 59, Caracas—
Refinery: Guario. Daily crude-oil capacity, 120 bbl.; type, distillation.

Texas Petroleum Co., Tienda Honda a Puente 59, Caracas—
Refinery: Tucupita. Daily crude-oil capacity, 10,000 bbl.; type, distillation.

Venezuelan Gulf Refining Co.—
Refinery: Puerto La Cruz. Daily crude-oil capacity, 30,000 bbl.; type, distillation.

WALES

National Oil Refineries, Ltd., Britannic House, Finsbury Circus, London, E. C. 2—
Refinery: Llandarcy. Daily crude-oil capacity, 60,000 bbl.; daily cracking capacity, 4,000 bbl.; type, complete. (Catalytic cracking unit having 10,000 bbl. daily capacity to be in operation by end of 1952.)

WEST INDIES

Operating refineries 9
Crude-oil-capacity rating, bbl. per day 724,300
Cracking-capacity rating, bbl. per day 376,000

ARUBA

Lago Oil & Transport Co., Ltd., Aruba—
Refinery: Aruba. Daily crude-oil capacity, 390,000 bbl.; daily cracking capacity, 228,000 bbl.; type, distillation, cracking, asphalt.

Arend Petroleum Mij., Willemstad, Oranjestad, Aruba—
Refinery: Oranjestad. Daily crude-oil capacity, 27,000 bbl.; daily cracking capacity, 3,000 bbl.; type, distillation, cracking.

CURACAO

N. V. Curacaosche Petroleum Industrie Mij., Carl Van Bylandtlaan 30, The Hague—
Refinery: Willemstad. Daily crude-oil capacity, 200,000 bbl.; daily cracking capacity, 100,000 bbl.; type, complete. (Part of crack-

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ing capacity currently operating in distillation service.)

TRINIDAD

Brighton Terminal, Ltd., Brighton—
Refinery: Brighton, La Brea. Daily crude capacity, 4,000 bbl.; type, distillation, asphalt.

Kern Trinidad Oilfields, Ltd., 36-38 Kingway, London, W. C. 2, England—
Refinery: Guapo. Daily crude-oil capacity, 1,000 bbl.; type, distillation.

Trinidad Leaseholds, Ltd., Trinidad House, 29/30 Old Burlington St., London, W. 1, England—
Refinery: Pointe-a-Pierre. Daily crude-oil capacity, 70,000 bbl.; daily cracking capacity, 45,000 bbl.; type, distillation, cracking.

Trinidad Lake Asphalt Operating Co., Ltd. (General Asphalt subsidiary), Barber, N. J.; Philadelphia, U.S.A.—
Refinery: Brighton. Daily crude-oil capacity, 1,000 bbl.; type, distillation, asphalt.

Trinidad Oilfields Operating Co., Ltd., Port-of-Spain—
Refinery: La Brea. Daily crude-oil capacity, 1,300 bbl.; type, distillation.

United British Oilfields of Trinidad, Ltd., 15 Abercromby St., Port of Spain—
Refinery: Point Fortin. Daily crude-oil capacity, 30,000 bbl.; type, distillation, asphalt.

YUGOSLAVIA

Information on current status of refinery operations in Yugoslavia is not available.

Abadan Project Progressing

Work is progressing on Anglo-Iranian Oil Co., Ltd.'s new catalytic cracking unit at the Abadan refinery, and completion date has been set for early 1951. The unit will have a capacity of 30,000 bbl. daily.

On a crude-oil-capacity basis, this refinery is the world's largest with a rating of 500,000 bbl. daily. The new catalytic unit will raise the plant's over-all cracking capacity to 130,000 bbl. daily. By mid-1951, a new 400 bbl. daily lubricating-oil plant is expected to be in operation.

China Exports Insignificant

WASHINGTON. — Charges aired before a congressional committee last month that a considerable volume of lubricating oil and other products had been permitted to reach communist China were met last week by Secretary of Commerce Charles Sawyer with a flat statement that shipments were "of no strategic significance, particularly in the light of the relatively small quantities involved."

Sawyer declared that no licenses have been issued since January 1950, for the shipment to China of any aviation fuel or lubricating oil; automotive fuels; diesel, heating, or other fuel oils, or kerosine; and only a small amount of other lubricating oils.

He intimated that such exports as have been permitted to go to China were licensed to encourage the continued supply of Chinese products of strategic importance to us, such as tungsten, tin, hog bristles, tung oil, etc. As a result, our imports from China have been held fairly constant at something over $100,000,000 a year, he said.

Big Oil Tanker Launched

One of the world's largest tankers, the 31,550-ton Berenice, was launched recently in Saint Nazaire, France. Built by Cie. Auxiliaire de Navigation with French Government assistance, the vessel has a cargo capacity of 39,000 cu. m., or about 245,000 bbl.

Speed of the ship fully loaded will be 15½ knots. The Berenice will take another 10 months for fitting out, while a sister ship, the Bethsabee, will be launched late next spring.

The Berenice is somewhat smaller in dimensions than the supertankers which have been built for Atlantic Refining Co. at Camden, N. J. The French vessel has a 619-ft. length between perpendiculars against 625 ft. for the Atlantic tankers. The Berenice is powered with 13,560 hp., while the Atlantic ships have approximately 18,000 hp.

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QUESTIONS on TECHNOLOGY

by W. L. Nelson
Consulting Engineer

This department was created for the purpose of aiding managers, superintendents, engineers, chemists and all those engaged in various phases of plant operation, as well as those connected with the marketing and utilization of petroleum products. Readers are invited to submit their problems to W. L. Nelson, technical editor. Inquiries must be signed, but only the initials will be printed.

Vanadium in Crude Oil—III
Effect of Ash on Refractories

Note: This is a continuation of the several questions stated in the issue of November 30 entitled, "Vanadium in Crude Oil—1 Occurrence."

Such confusion exists regarding the deleterious effect of ash upon the walls of boilers or stills that there seems to be little chance of discovering the true condition until more complete records or information are available. In examining some installations and in questioning the operators, exactly opposite reports are sometimes obtained. The author, in questioning plant operators and the superintendents of two refineries that burn high-vanadium fuel, learned that no difficulties have been encountered with the refractories, whereas another examiner reported molten slag on the floor of the still and that bridge-wall temperatures must be kept below 1,400° F. in order to avoid sloughing of the walls.

In addition, it is not known with certainty which component or components in an ash are responsible in certain commercial failures that have occurred. Many common components in petroleum ash such as lime, ferrous oxide, alkali salts, etc., are known to form slag with common refractories at low temperatures and reducing atmospheres are known to have caused, at high temperatures, the formation[1] of suboxides of silicon, titanium, zirconium, boron, vanadium, etc., which may contribute to the failure of furnace walls. Even hydrogen at a temperature of only 932° F., has been blamed for the failure of high-silicon refractories. Likewise, small additions of the oxides of molybdenum, vanadium, tungsten, antimony, nickel, cobalt, manganese, and uranium increase the spreading power (decrease the surface tension) of certain glazes, glasses, and enamels.[2] These additions result in a slag that spreads easily over surrounding surfaces and thus contributes in a sense to the fluidity of the slag. Molybdenum trioxide appears to reduce the surface tension more than other oxides.

The fact remains that petroleum ash that is high in vanadium has been associated with refractory failures. It is of little consequence whether the failure was due particularly to vanadium, to the amount of ash, to the presence of reducing atmospheres, or to the action of other unknown components or factors, if it can be shown that the failures are always associated with those of ashes which contain sizable amounts of V_2O_5.

In the face of this confusion, nothing remains but to record everything that has been heard. One eyewitness and an expert on combustion and furnaces reports that high-vanadium ash appears to produce an eutectic (low-melting compound) with almost any common refractory. This necessitated maximum bridge-wall temperatures in petroleum pipe stills of 1,400° F. in one large Caribbean refinery. At another Caribbean refinery molten slag was found on the floor of a pipe still and the fireman reported that the slag was caused by a 1½-hour operation at 1.550° F. About 2½ in. of the wall had sloughed off, enough so that the tile hanger supports could be seen. He also stated that carborundum which is used up to 2,700°-3,000° F. in the United States must be kept below 1,600° F. when burning high-vanadium fuel.

Finally, he reports a boiler operating in West Virginia for many years on fuel oil of United States origin, which lost its walls when operating for only a few weeks on high-vanadium fuel oil. However, conditions may not have been too bad because operators and the superintendents of the two refineries mentioned above did not feel that they had encountered any furnace refractory trouble. Perhaps they had become accustomed to operating at low furnace temperatures and were not aware of the hard firing conditions maintained in certain other refineries. They did report minor trouble with metal tube support hangers. At one time they attempted to cover the supports with a layer of refractory, but difficulty was encountered in keeping the refractory from cracking off and hence the practice was abandoned.

In summary, it appears certain that large amounts of ash, particularly those high in vanadium, contribute under some conditions to the failure of customary furnace refractories. A suggested solution to the difficulty is the maintenance of a bridge-wall temperature (or its equivalent) lower than 1,400° F. In oil-fired pipe stills the bridge-wall temperatures recorded by thermocouples are somewhat as follows when operating at 25 to 45 per cent excess air:

Radiant surface	B.t.u. per sq. ft. outside area	
Large	6,370	1,200°-1,400° F.
Small	16,000	1,700°-1,800° F.

Thus, if temperatures below 1,400° F. are to be maintained, it is necessary to employ large-radiant-surface pipe stills. This is the type of still that is now being built almost exclusively in refineries. Older stills with small radiant sections will probably encounter difficulties and may have to be operated at low capacity if difficulties with high-vanadium ash are to be avoided. Radiant absorption rates of about 9,000 B.t.u. per sq. ft. (28,000 on projected area) seem to be about the upper limit.

The discussion of effects on refractories will be continued next week.

References

1. Zapffe, C. A.—"Conversion of Certain Refractory Oxides to a Suboxide Form at High Temperature," Jour. Am. Ceram. Soc., Vol. 27, p. 293 (1944).

2. Amberg, C. R.—"Effect of Molybdenum and Other Oxides on Surface Tension of Silicate Metals and on Properties of Refractories and Abrasives," J. Am. Ceram. Soc., Vol. 29, p. 87 (1946).

Crude Breakup Throughout World

How does the Bunker C fuel-oil production of United States refineries compare with the production of foreign refineries?—S. T. P.

It is presumed that the percentage of Bunker C production is desired. R. P. Russell in his Program in Petroleum Research, Petroleum, July 1947, page 151, states the figures shown in Table 1.

It will be noted that the production of residual fuel throughout the world is larger than in the United States. The same applies to kerosine and distillates.

TABLE 1—PERCENTAGE YIELD FROM A BARREL OF CRUDE OIL

	United States					Foreign*		
	1920	1930	1940	‡1950	‡1960	1928	1938	‡1950
Motor fuel	25.8	41.9	43.1	42.2	45.9	23.4	27.9	26.7
Kerosine	12.7	5.3	5.7	5.0	5.2	11.5	8.2	6.1
Gas oil and distillate	(†)	8.8	14.2	18.2	21.7	(†)	17.3	16.7
Residual fuel oil	†48.7	31.4	24.4	20.1	12.3	†54.0	36.6	41.9
Lube oils	5.8	3.7	2.8	2.4	2.3	2.9	2.2	1.7
Others, loss, etc.	7.0	8.9	9.8	12.1	12.6	8.2	7.8	6.9

*Not including Russia. †Gas oil and distillate included with residual fuel oil. ‡Estimated.

Another technical editor confirms reasons why engineers prefer Gurley Aluminum Transits

Combining durability and lightness with precision for surveying transits

by David W. Veit
Editor, Die Castings Magazine

MANY surveying instruments built by W. & L. E. Gurley, Troy, N. Y., are accurate within one second of arc. If projected, this represents a maximum error of ⅝ inch in a mile.

However, precision is not the only requirement of these instruments. At least three other major factors influence the design and choice of materials for this type of equipment.

In the first place, a surveyor's transit must not only *be* accurate, but must maintain its accuracy over an indefinite period of years despite all sorts of weather and climatic conditions —heat, sub-zero temperatures, dampness, dust or salt-saturated atmospheres.

Second, it must withstand rough usage. This is outdoor equipment subjected to impact and abrasion.

The third requirement — no less important than the other two to the surveyor who carries the transit around all day long —is lightness.

The combination of accuracy and ruggedness could be secured by constructing the transit of heavy-sectioned castings, forgings or fabrications in steel or bronze, extensively machined and elaborately assembled. This choice of materials would, however, fail to include one significant feature—lightness.

The way in which Gurley has been able to combine all three desirable features has been by turning to aluminum for a major group of components. And since aluminum has been picked to fulfill the physical and mechanical needs of these surveyor's transits, it is not surprising that several of the most important parts are being produced most economically by die casting.

Die cast aluminum parts include the truss standard, telescope housing and leveling spider, as well as rod targets and tripod clamps. Aluminum alloys used for these transits have greater stability and rigidity than bronze. In addition, the die casting process permits unitary construction of the mounting frame, contributing further to rigidity.

From the point of view of weight reduction, aluminum die castings have permitted a 25 percent decrease in total weight, as compared with sand cast bronze. Die cast aluminum offers additional weight saving advantage, even as compared with sand cast aluminum, due to the thin, uniform wall section which is practical by die casting.

This pioneering instrument builder has used aluminum die castings wherever possible; this is one of the few production short cuts possible in a manufacturing operation characterized by extensive machining, finishing and assembling operations within close tolerances.

This company has maintained its leadership in the field of engineering and other types of instruments by a willingness to investigate and introduce into their production line the new materials and methods made available by technological advance. The excellent reputation of this company's instruments during the past century is sufficient testimony for the reliability of the materials which they use.

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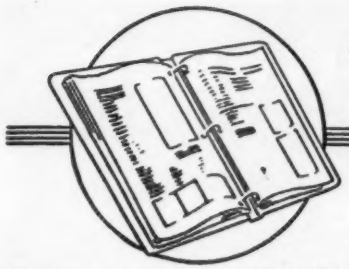

THE REFINER'S notebook

Summary—Tri-Act Control

THE conventional proportional-reset-derivative controllers have been compared with a new three-function control system termed "Tri-Act" control, on the basis of operating principle, start-up characteristics, and controller settings for sensitivity, reset rate, and derivative time. Controller settings in terms of dial readings have been compared (Equations 5 and 6, Installment No. 50) as follows:

$$nS' = S/(1 - RT) \text{ and}$$

$$R' = R \text{ and } T' = T \qquad (1)$$

Also,

$$nS' = RTS/(1 - RT) \text{ and}$$

$$R' = 1/T \text{ and } T' = 1/R \qquad (2)$$

where S, R, and T are sensitivity, reset rate, and derivative time settings on the conventional controllers, and S', R', and T' are corresponding settings on the new controller. The symbol, n, represents the gain in the reset relay of the new controller.

Equations 1 and 2 offer a great deal of information about the new controller. For example, if a conventional controller has been properly set up and adjusted to the process the values of S, R, and T are known. It has been well established that the product of RT cannot equal 1, and as a matter of fact, Ziegler and Nichols indicate that this product should be in the neighborhood of ¼. If this is the case, the product of the apparent sensitivity and the gains (nS') in the new controller must be one-third greater than the sensitivity reading on the old controller, according to Equation 1. With this particular sensitivity, the reset rate (R') and the derivative time (T') reading are identical with those on the conventional controller.

However, Equation 2 proposes another solution in the adjustment of sensitivity, reset rate, and derivative time. Again, following Ziegler and Nichols' recommendations, when RT = ¼ from Equation 2 the apparent sensitivity of the proposed controller can be one-third of the reading on the conventional controller while the new reset rate is the reciprocal of the former derivative time, and the new derivative time is the reciprocal of the former reset rate. Note that the product of the new reset rate and the derivative time settings (R' T') is 4.

This installment of Refiner's Notebook concludes the current series on refinery instrumentation. A new series about greases—what they are and how they work—begins in the December 28 issue of the Refiner's Notebook. This new series was prepared to cover a phase of modern petroleum development and application which is generally not well understood and about which little has been written.

This second solution is extremely interesting for it points out that in this new controller the sensitivity setting (the dial reading) can be lowered to one-third of its previous value and yet the actual sensitivity of the controller will be unchanged provided the reset rate and the derivative time dials are adjusted in accordance with the recommendations of Equation 2. In other words, the actual sensitivity of this controller in the second set of adjustments can be identical with the sensitivity of a corresponding conventional controller, and yet the dial reading can be considerably below the values previously established. The importance of this suggestion is not that there are two methods of obtaining the same results with a controller, but that this second method with its broader throttling range (lower sensitivity) enables the controller to prevent overpeaking during startup conditions on difficult applications.

In adjusting a controller in the conventional manner the sensitivity would be lowered until stability was obtained. The reset and derivative functions would then be cut in and in all probability the series of settings suggested by Equation 1 would result. Under these conditions, it is quite likely that when the process is started up, overpeaking would still occur although it would be less than with the conventional controller since the first proportional band has not been shifted above the control point. Now, by lowering the sensitivity of this controller to one-fourth of this value and setting the reset rate and the derivative time in accordance with Equation 2 at considerably higher values, identical performance following load changes can be obtained, and at the same time the controller will not overpeak on startup. While this control system offers great advantages on batch and semicontinuous operations where startup may occupy the greatest portion of the processing time, the system also has merit on continuous operations.

One factor which must be remembered in using this new system is that if the control problem is approached in the conventional manner, the full benefits of the control system may not be realized. While it is true that the overpeaking will be less than with the conventional controller, particularly if it does not have the derivative function, it is also true that the overpeaking may not be entirely eliminated. The elimination may always be accomplished by lowering the controller sensitivity and at the same time increasing the reset rate and the derivative time.

Finally, there are many values of S', R', and T' which lie between the values mentioned. These values will produce stable control but the performance following a load change will differ. Still, this performance may be entirely satisfactory, while the performance of the controller on startup may be considerably improved. It is suggested that these values of S', R', and T' be more fully investigated on actual processes and on analogs to determine the values which produce the best startup characteristics. As a suggested criterion, the controller performance is best on startup when the control point is reached with a minimum delay without overpeaking.

No. 51 in current series. The Refiner's Notebook has been published continuously since 1944.

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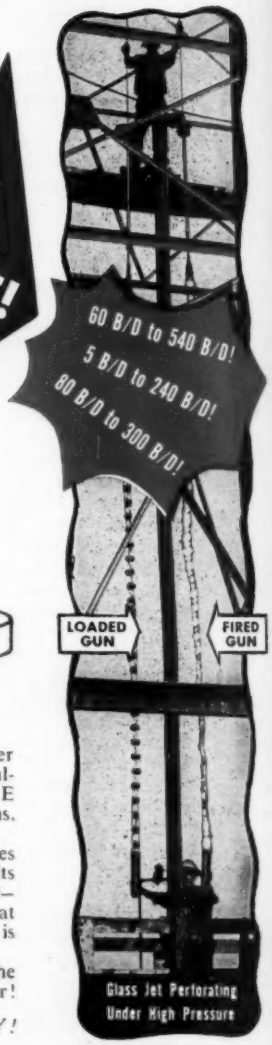

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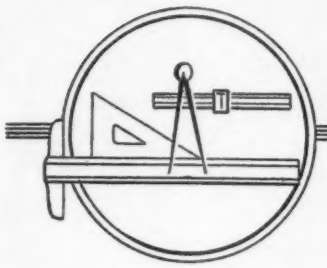


ENGINEERING

No. 429 *fundamentals*

Variations of Material Balance

ALTHOUGH the material balance is usually written covering the time from discovery to some depletion point in a reservoir's history it can as well be used otherwise. Some variations of this nature have been used from time to time by reservoir engineers for specific purposes. One such use is to employ the equation over a time interval and evaluate water encroachment (Engineering Fundamentals No. 428). Others will be outlined here.

If a reservoir is known to be a solution-gas drive with an original gas cap the material-balance equation can be employed over successive time intervals to evaluate the size of the gas cap provided production data are sufficiently reliable. The equation, written at times 1 and 2 (representing two points after discovery at which pressure and gas oil ratio surveys are available) gives, after subtraction for the interval, the following:

$$N\,[(u_2 - u_1) + mu_o\,(v_2 - v_1)/v_o] = \Delta N_2\,[u_2 + (R_{c2} - r_o)\,v_2] - \Delta N_1\,[u_1 + (R_{c1} - r_o)\,v_1] \quad (1)$$

where subscripts 2 and 1 refer to the times 2 and 1. The material-balance equation written for times 3 and 4 and subtracted yields a similar equation,

$$N\,[(u_4 - u_3) + mu_o\,(v_4 - v_3)/v_o] = \Delta N_4\,[u_4 + (R_{c4} - r_o)\,v_4] - \Delta N_3\,[u_3 + (R_{c3} - r_o)\,v_3] \quad (2)$$

In these equations, both m and N are unknown, but since the two equations apply for separate and independent time intervals they can be solved simultaneously to give an estimate for the size of the oil zone as well as for the gas cap. The use of the technique should be predicated upon reasonable knowledge of the absence of water drive and of the accuracy of the data. This use is equivalent to finding by trial and error a value of the gas cap, m, which would produce reasonably constant values of oil in place in the material balance calculation at successive times.

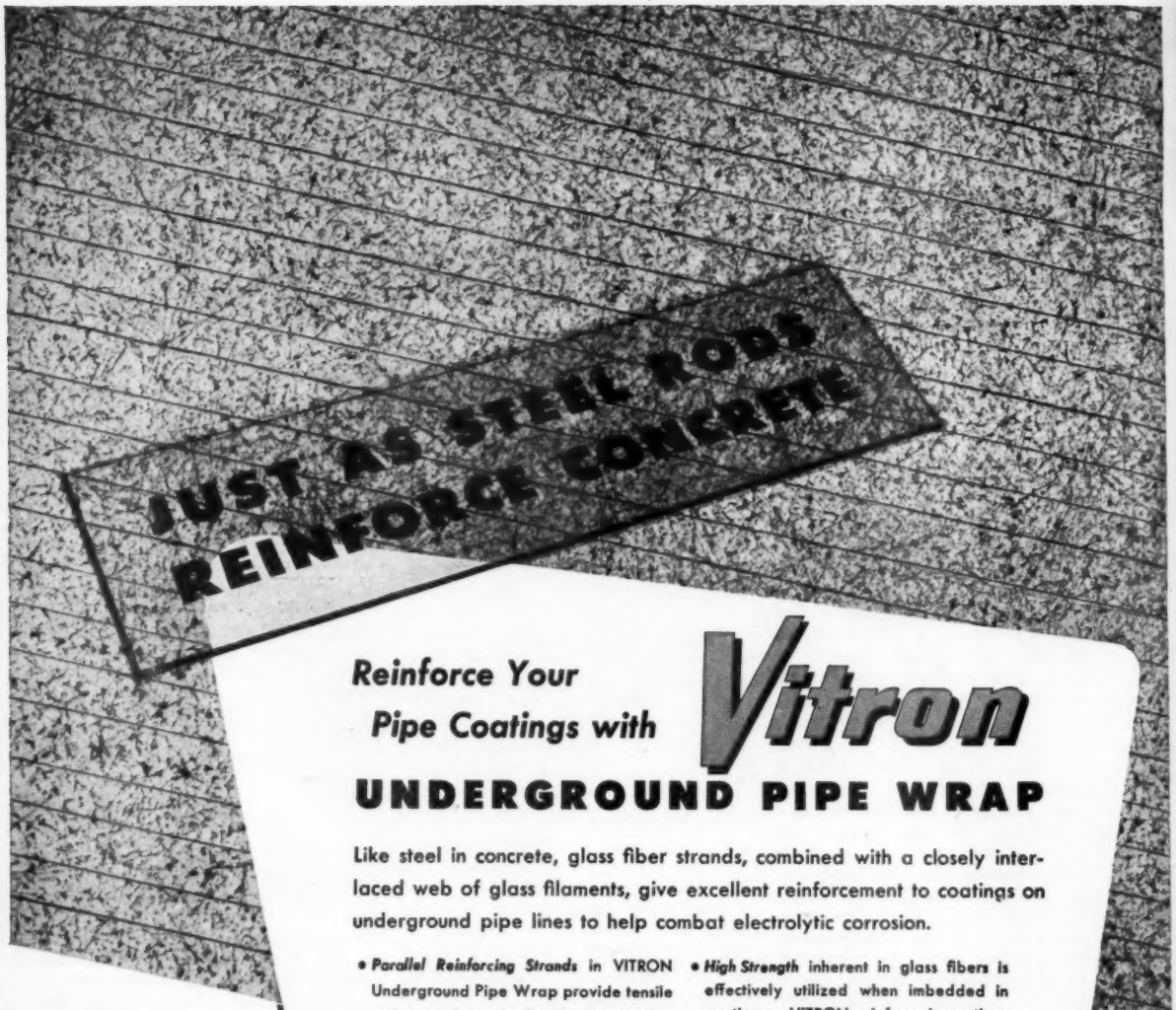
The use of the material balance over time intervals after the reservoir has produced has certain advantages for accuracy. In Equation 1, for example, the values of u_2 and u_1 are determined by the reservoir pressures measured at these two times. Both of these pressures are averages determined after taking pressures over the entire reservoir. Both are probably in error from a true reservoir pressure in the same direction and perhaps by similar magnitudes. Also, neither of these pressures may represent static readings because sufficient time was not available to obtain static values. The difference between u_2 and u_1, therefore, would perhaps be more correct than would the difference between either u_2 or u_1 and the original value of u. The same can be said of the quantity $(v_2 - v_1)$ compared to either $(v_2 - v_o)$ or $(v_1 - v_o)$.

The material-balance equation can also be written with the initial time being any place during the reservoir's history rather than at discovery. This use is equivalent to stating that the reservoir is discovered under a state of depletion and the balance is carried on from there. Advantages of this method would be apparent where gas data or any other data were missing or were unreliable prior to a certain time. The disadvantage lies in the necessity of estimating the free gas saturation at the time the balance is started. The equation would be written as

$$(N - \Delta N_1)\,[(u - u_1) + m'u_1\,(v - v_1)/v_1] = (\Delta N - \Delta N_1)\,[u + (R_c' - r_1)\,v]$$

in the absence of any water drive. In the equation, N still represents the oil in place upon discovery, ΔN_1 represents the production of oil up to the point when this balance is started, and ΔN represents the production of oil at any new time after the balance has started. Subscripts 1 on other quantities represent also starting conditions; m′ is the size of the gas cap at the starting point of the balance, or, in this case of partial depletion, would be whatever free gas existed in the reservoir divided by the stock tank oil in place at the time the balance started. In the absence of an original gas cap this term could be estimated from the oil and gas saturations as determined by the producing gas-oil ratio at the start of the balance. R_c' is the cumulative net gas-oil ratio beginning with the time at which the production was ΔN_1. The values of u_1 and u are calculated as characteristics of the reservoir oil already partially depleted at the time the balance was started; they are not based on original reservoir conditions.

Series by Dr. John C. Calhoun, Jr., Chairman, Petroleum Engineering School, Penn State College



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PIPE LINES

Foreign Construction

It broke all records in 1950 with a total of 3,160 miles of projects completed; 6,500 miles planned for future

Paul Reed

FOREIGN pipe-line construction in 1950 broke all records with a total of 3,160 miles of projects completed. The largest of these were the systems of Trans-Arabian Pipe Line Co. in the Middle East and Interprovincial Pipe Line Co. in Canada. Pipe lines still under construction abroad total 1,630 miles.

Of the 6,650 miles of line planned for the future, approximately 4,900 miles would be for natural gas, 1,250 miles for crude oil and 700 miles for products.

As soon as the Province of Alberta grants export permission, extensive systems will be undertaken for gas transmission to other Canadian provinces and the United States. Construction of new lines of various kinds will be under way in 1951 in Venezuela, Colombia, Brazil, and the Middle East.

Foreign Crude-Oil Pipe Lines—Planned and Under Way

Cia. de Petroleo Ganso Azul, Ltd.—48 miles, 4-in., planned, Ganso Azul field to Pucalpa on upper Ucayali River, Peru.

Condor S.P.A. (Shell).—80 miles, planned, Genoa to Rho, near Milan, Italy.

Direccion General de Yacimientos Petroliferos Fiscales.—409 miles, under way, Plaza Huincul to Bahia Blanca, Argentina.

Iraq Petroleum Co., Ltd.—556 miles, 30-32-in., under way, Kirkuk, Iraq, to Banias, Syria, 1952; Bechtel-Kirkuk, contractor.

Middle East Pipelines, Ltd.—800 miles, 34-36-in., planned, Iran to a Levantine port.

Petroleos Mexicanos.—160 miles, 10-in., under way, Minatitlan to Salina Cruz, Mexico.

Petroleos Mexicanos.—145 miles, 12-in., considered, 18 de Marzo field via Reynosa to Monterrey, Mexico.

Shell Caribbean Petroleum Co.—11 miles, 16-in., authorized; Bachaquero (north) to Lagunillas, Venezuela, 5-51.

Shell Caribbean Petroleum Co.—165 miles, 30-in., authorized; Palmarejo to terminals on the Paraguana Peninsula (Cardon and Las Piedras, Venezuela), 12-51.

Foreign Products Pipe Lines—Planned and Under Way

Colombia Ministry of Petroleum.—90 miles, 6-in., planned, Puerto Berrio to La Dorada, Colombia.

Colombia Ministry of Petroleum.—103 miles, 4-in., planned, Puerto Berrio to Medellin, Colombia.

Colombian Ministry of Petroleum.—75 miles, 4-in., planned, Buena Ventura to Cali, Colombia.

Estrada de Ferro Santos Jundiai.—32 miles, 10-in., under way, Santos to Sao Paulo, Brazil; Techint, contractor.

Estrada de Ferro Santos a Jundiai.—32 miles, 18-in., under way, Santos to Sao Paulo, Brazil (fuel oil line); Techint, contractor.

Northern Pipe Line, Ltd.—300 miles, 10-in., planned, Montreal, Que., to Toronto, Ont., Canada.

Petroleos Mexicanos.—160 miles, 10-in., under way, Minatitlan to Salina Cruz, Mexico.

State of Cundinamarca, Colombia.—120 miles, planned, Puerto Salgar, to Bogota, Colombia.

Foreign Natural-Gas Pipe Lines—Planned and Under Way

Azienda Generale Italiana Petroli.—Under way, Lodi to Milan, Italy.

Azienda Generale Italiana Petroli.—Under way, Lodi to Turin, Italy.

Azienda Generale Italiana Petroli.—Under way, Lodi to Genoa, Italy.

Direccion General del Gas del Estado.—310 miles, 8-in., under way, Plaza Huincul to Neuquen, Argentina, to the vicinity of General Conesa, Argentina.

Direccion General del Gas del Estado.—62 miles, under way, Comodoro Rivadavia to Caleta Olivia, Argentina.

Northwest Natural Gas Co.—950 miles, 24-in., planned, Alberta fields to Vancouver, B. C., Seattle, Wash., and Portland, Ore.

Petroleos Mexicanos.—205 miles, 16-in., considered, Monterrey to Torreon, Mexico.

Petroleos Mexicanos.—260 miles, 20-in., considered, Monterrey to Tampico and Poza Rica, Mexico.

Petroleos Mexicanos, Mexican Gas Co., and Industrial Gas Co.—600 miles, planned, Reynosa, Tamaulipas, to Mexico City, D. F.

Venezuela Atlantic Transmission Corp.—195 miles, 10-12-16-in., planned, El Placer near Las Mercedes, State of Guarico to Caracas, La Guaira, Maracay, and Valencia.

Westcoast Transmission Co., Ltd.—1,408 miles, 30-in., planned, northern Alberta to Vancouver, B. C., and northern California.

Western Pipe Lines.—1,200 miles, 22-in., planned, Southern Alberta to Duluth, Minn.

Foreign Crude-Oil Projects—Completed

Arabian American Oil Co.—Ain Dar to Abqaiq, Saudi Arabia, 30 miles, 20-22-24-in.

Basrah Petroleum Co. (Affiliate of Iraq Petroleum Co.).—72 miles, 12 and 16-in., Zubair to Fao,

Direccion General de Yacimientos Petroliferos Fiscales.—25 miles, Tupungato-Lujan de Cuyo, Argentina.

Interprovincial Pipe Line Co.—1,150 miles, 16-18-20-in., Edmonton, Alta., to Superior, Wis., 10-50; Canadian Bechtel, Ltd., Fred Mannix Co., and Williams Brothers Corp., contractors.

Mene Grande Oil Co.—7 miles, 16-in., loop in Anaco-Puerto La Cruz section, Venezuela, Chicago Bridge & Iron, contractor.

Mene Grande Oil and Creole Petroleum.—15 miles, 16-in., loop Oficina-Anaco, Puerto La Cruz, Venezuela.

Montreal Pipe Line Co., Ltd.—68 miles, 18-in., completed, near Highwater, Que.; to Montreal East; Fred Mannix & Co., contractor of Section 3.

Petroleos Mexicanos.—280 miles, 12-in., Poza Rica to Salamanca, Mexico.

Shell Caribbean Petroleum Co.—18 miles, 4-in., completed, Mara to Palamarejo, Venezuela.

Shell Caribbean Petroleum Co.—16 miles, 14-in., completed, Tia Juana to Cabimas, Venezuela.

Trans-Arabian Pipe Line Co.—1,068 miles, 30-31-in., Abqaiq, Saudi Arabia, to Sidon, Lebanon, 10-1; Williams Brothers Overseas Co. and International Bechtel, Inc., contractors.

(Continued on page 339)

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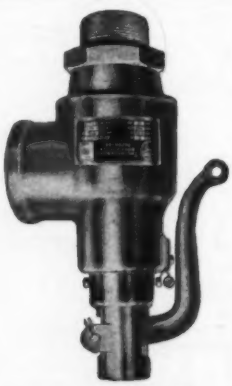

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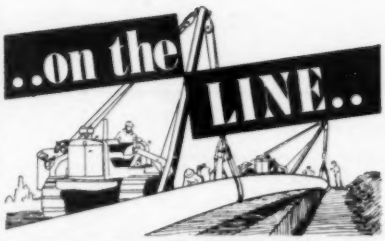

Bechtel Has Major Role in World's Pipe-Line Laying

BECHTEL CORP., and affiliated Bechtel interests have a major role in world-wide pipe-line construction. During 1950 Bechtel crews have been engaged in laying lines for contracts totaling 3,733 miles for nine projects. Four of these are located outside the United States—the Trans-Arabian, Arabian American, Iraq Petroleum, and Interprovincial lines.

The largest domestic Bechtel project is the 506-mile, 34-in. ("Super Inch") for Pacific Gas & Electric Co. A record was broken when 56 miles of wrapped 34-in. was finished from line-up to backfill during last August.

History. — Today's extensive operations in pipe-line engineering and

S. D. BECHTEL

VAN ROSENDAHL

construction grew from a start in 1929 by a predecessor company owned by W. A. Bechtel and his three sons. The original Bechtel contracting business began in 1898.

W. E. WASTE

V. G. HINDMARSH

In addition to the Canol project, and war work at bases, shipyards, refineries, chemical plants, open-pit mining, and other defense jobs, Bechtel laid two sections of the War Emergency "Big Inch," converted a 400-mile California gas line to oil, and carried out several assignments in the Mid-Continent.

Postwar work included a 176-mile, 20-in. line for Standard Oil Co. of California and 340 miles of 24-in. for Tennessee Gas Transmission Co. Operations have continuously increased in the last 2 years.

Present investment in spread equipment for the Bechtel organization exceeds $25,000,000.

Personnel.—Stephen D. Bechtel, president, Bechtel Corp., the prime mover, expanded the earlier firm's activities

G. S. COLLEY, JR.

CLARK RANKIN

into pipe-line construction; he was field superintendent on first jobs. Now he maintains close contact with progress through frequent field trips. Van W. Rosendahl, vice president, Bechtel Corp., and president of the two international companies, has top responsibility for major pipe-line operations. W. E. Waste heads administration, including sales, for all com-

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pany operations. V. G. Hindmarsh, vice president, is a senior engineer who directed the "Super Inch" job. George S. Colley, Jr., executive vice president of International Bechtel, Inc., has been in charge of construction for Tapline. Clark Rankin, vice president, Arabian Bechtel Co., the responsible head of Bechtel's Kuwait operations, currently directs the Iraq Petroleum project. E. W. Davis, vice president, Canadian Bechtel, Ltd., is project manager of the 420-mile Bechtel contract-section of the Texas-Illinois gas line.

Roy McAuliffe, vice president, International Bechtel, Inc., has been project manager of Tapline. Al Berlander, general superintendent, the Bechtel pipeliner with longest service with the firm, was construction manager on Tapline and is now active on the Texas-Illinois job. R. L. Bowman, general superintendent, another company veteran, was chief on "Super Inch." Ray Hamilton, pipe-line consultant, has served in various engineering and supervisory capacities on domestic and foreign work.

Other key men are Ed Lannan and Roy Moody, pumping-station superintendents on Tapline; Roy Middleton, pipe-line superintendent at Bahrein; and R. G. Rhoades, welding consultant. Stephen D. Bechtel, Jr., is currently superintendent of river crossings on the Texas-Illinois job. J. S. Connell, a Bechtel veteran, manages a separate activity of Bechtel Corp. which is the manufacture and application of Somastic Pipe Coating, in 11 Western states and abroad.

(Continued from page 337)

Venezuelan Atlantic Refining Co. — 12 miles, 8-in., Ruiz to Sabon, Venezuela.

Winnipeg Pipe Line Co., Ltd.—75 miles, 10-in., Gretna to Winnipeg, Manitoba; Sparling-Fowler Co., Ltd.

Foreign Products Pipe Lines—Completed

Creole Petroleum Corp.—10 miles, 8-in., Catia de la Mar to Nueva Caracas, Venezuela, 11-50; Macco-Panpacific, contractor.

Shell Caribbean Petroleum Co.—26 miles, 2-in. (butane and natural gasoline), La Paz to Palmarejo, Venezuela.

Shell Caribbean Petroleum Co.—17 miles, 3-in. (butane), Mara to La Paz, Venezuela.

Shell Caribbean Petroleum Co.—15 miles, 16-in. (water), Carrasquero (Rio Limon), to Mara, Venezuela.

Shell Caribbean Petroleum Co.—19 miles, 12-in. (water), Mara to La Paz, Venezuela.

Foreign Natural-Gas Pipe Lines—Completed

Petroleos Mexicanos.—60 miles, 8-in., Monterrey to Saltillo, Mexico, 12-15.

Westcoast Transmission Co.—Alberta gas fields to Dawson Creek, B. C., Canada.

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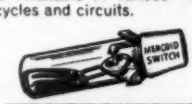

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NATURAL GAS

T.G.T. Asks Expansion O.K.

WASHINGTON. — Tennessee Gas Transmission Co., Houston, has asked the Federal Power Commission for permission to carry out a $47,403,000 expansion program which would increase its system capacity by 115,000,000 cu. ft. of natural gas per day. The gas would be delivered at the United States-Canadian International border for ultimate consumption in Toronto and other markets in Ontario.

This project, which would enlarge Tennessee's system to 1,425,000,000 cu. ft., would include a 45-mile line extending from Buffalo to a point on the U. S.-Canadian border near Niagara Falls, N. Y. Gas would be delivered to Niagara Gas Transmission, Ltd., a newly formed Ontario corporation controlled by Consumer's Gas Co. of Toronto, for resale.

Tennessee would also build about 266 miles of loop line in sections along its existing system between Texas and Buffalo, new compressor units, and about 100 miles of lateral lines.

In an FPC ruling, Tennessee Gas has been ordered to connect its pipeline system with facilities to be built by the city of Ripley, for the delivery and sale of natural gas to Ripley, Booneville, and Baldwyn, Miss.

Utah Seeks New Line

WASHINGTON.—Utah Pipe Line Co. has asked the Federal Power Commission for permission to construct and operate a 392-mile natural-gas transmission line from a point near Aztec, N. M., to the Salt Lake City area. Estimated cost is about $22,000,000.

The main-line facilities would consist of approximately 374 miles of 22-in. line and 18 miles of 16-in. line. The system would have a maximum capacity of 96,000,000 cu. ft. per day and would serve the Salt Lake City area, plus towns along the route of the line in Colorado and Utah.

Panhandle Rate Change

WASHINGTON. — Spokesmen for Panhandle Eastern Pipeline Co. have advised the Federal Power Commission that the company does not plan to continue natural-gas service to utilities which decline to accept proposed new rates. The proposed change in rates is scheduled for next fall when Panhandle completes its new pipe-line facilities, increasing its present capacity of 500,000,000 cu. ft. daily to 800,000,000 cu. ft.

Panhandle's rate expert, M. M. Farley, Kansas City, testified that the transmission company "cannot go along with the idea of continuing its present contracts with entire-requirements customers." These customers receive their entire supply of natural gas from Panhandle.

FPC Urged to O.K. Merger

WASHINGTON.—Executives of Colorado Interstate Gas Co. and Colorado Public Service Co. have urged the Federal Power Commission to approve a merger of Canadian River Gas Co. and Colorado Interstate to enable them to build a $12,000,000 pipe line from the Texas Panhandle to near Kit Carson, Colo.

The commission has approved the merger tentatively and is now conducting a hearing on the "reasonableness of payments" involved.

R. W. Hendee, president of Colorado Interstate, and F. T. Parks, vice president of Colorado Public Service, testified before the commission that a merger would make it possible to get a $12,000,000 loan to finance the line, and would mean savings to consumers.

Trico Field Line Laid

BAKERSFIELD, Calif.—In order to increase the field's daily gas output, Pacific Gas & Electric Co. recently laid a 2-mile, 8-in. line in Trico gas field near here in the San Joaquin Valley. Maximum daily output now is 70,000 M.c.f., or 10,000 M.c.f. greater than before.

Purpose of the line is to equalize pressure between the north end, where most of the gas is produced, and the lower-pressure south end. In the past, efforts to produce at greater than a 60,000-M.c.f. rate for any prolonged period caused sizable pressure drops in the south end. With the advent of cooler weather, the field output has been increased to 35,000 M.c.f. daily. Since last spring it has been cut back to about 6,500 M.c.f. daily.

Commissioner Reelected

WASHINGTON.—Commissioner Thomas C. Buchanan of Pennsylvania has been reelected vice chairman of the Federal Power Commission to serve during the calendar year of 1951. He had been elected vice chairman in May 1950.

He has been a member of the commission since July 14, 1948. From 1937 to 1945 he was a member of the Pennsylvania Public Utility Commission and of the predecessor Public Service Commission in 1936-37. He is a member of the Pennsylvania and American Bar associations.

Gas Protested in Coal Areas

ST. LOUIS.—Protest against the use of natural gas as a fuel to be used in heating government institutions located in coal-bearing areas has been made to Congress by the St. Louis Retail Coal Association.

Frank L. Keightley, chairman of the association's legislative committee, has formulated the protest in letters to congressional members from Illinois and Missouri. The instance of protest is the new John J. Cockran Veterans' Hospital now being erected in Vandeventer Place, St. Louis.

Construction plans specify equipment that will heat the big institution through the use of natural gas as a fuel. The association points out that coal fields in Illinois lie within 20 miles of the institution; that coal-mining provides work for thousands of people; that 95 per cent of known fuel reserves lie in coal; and that the St. Louis area has had no interruption in coal service for 25 years.

The association suggested that coal be used in all government institutions and domestic housing projects, particularly when situated in coal-consuming areas.

Natural Gasoline

Fleet Conversion Planned

A fleet of 15 buses to be powered with liquid petroleum gas has been ordered from Twin-Coach Co. to improve transportation in Little Rock and North Little Rock, Ark. The order was placed by Capital Transportation Co. which operates public bus systems in the two cities.

Tests have proven so attractive to the operators that plans are under way to convert 25 units of their present fleet to L.P.G. To service the new fuel, the company will construct a 30,000-gal. bulk propane station costing approximately $30,000. Reported cost of the new buses is $15,380 each.

Milwaukee Cabs Converted

MILWAUKEE.—Conversion of 270 taxicabs to the use of propane has been ordered by John P. Boynton Cab Co., following successful tests. Changes that enable the fleet to use liquid petroleum gas as fuel will cost $48,000.

Test cars reported advantages in saving of fuel costs, less motor wear, and reduction in exhaust fumes. Observers from other taxi fleets are said to be studying the test reports with a view to adoption of L.P.G.

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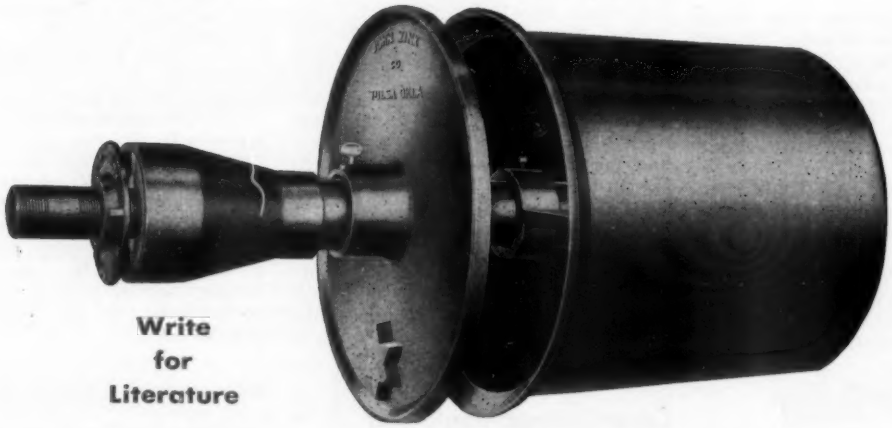

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REFINING

New Catalyst Developed

Success on a laboratory scale in the conversion of aromatic hydrocarbon mixtures to toluene and benzene was reported at the forty-third annual meeting of the American Institute of Chemical Engineers. In a paper entitled "Alumina Activated With Anhydrous Hydrogen Fluoride as a Dealkylation Catalyst for Aromatic Hydrocarbons," four investigators at Montana State College reported that the catalytic process had been used successfully on feed stocks containing ethylbenzene, xylenes, isopropylbenzene, diethylbenzenes, monoamylbenzene, diamylbenzene, and triamylbenzene.

The average run charged about 600 ml. of aromatic hydrocarbon over 900 ml. of catalyst at a space velocity of approximately 0.5 volume per volume of catalyst per hour at atmospheric pressure. The process dealkylated all of the aromatic hydrocarbons with two or more carbon atoms in every branch chain to benzene as the ultimate product. Those compounds with only one carbon atom in any branch chain yielded toluene as the ultimate dealkylated product. Toluene was not successfully dealkylated to benzene.

Comparative runs were made using unactivated alumina and hydrogen fluoride-treated alumina. The studies indicated that as the reaction temperature was increased, dealkylation increased and alkylation decreased. All aromatic dealkylation products resulted from a carbon-carbon fission at the benzene ring. The process has possible application in the conversion of higher molecular weight aromatics occurring in petroleum, to the basic benzene and toluene forms. Investigators predict the successful use of this process employing fluidized catalyst instead of the pelleted-catalyst fixed beds used in the laboratory studies.

Benzene Shortage Forecast

NEW YORK.—Production of benzene for the chemical and synthetic-rubber industries and for aviation-gasoline production will fall an estimated 12,000,000 gal. short of demand next year, reports L. A. Schleuter of the American Coke and Coal Chemicals Institute.

In addressing the Chemical Market Research Association here, Schleuter stated that 1951 production from all sources will approximate 212,000,000 gal., but that rising demand from all types of consumers will boost the demand to 225,000,000 gal. Total consumption this year was estimated at 188,000,000 gal.

The coal-chemicals industry spokesman cited the petroleum industry as the potential source of added benzene. Chemical manufacturers and oil company representatives met in Washington December 13 at the request of the National Production Authority, to consider expansion of supplies from petroleum.

New Spectrochem Reference

An important new reference work for analysts employing spectrometry is now available in the form of an up-to-date compilation of all current information on spectrochemical standard samples. The report, compiled by Subcommittee IV on Standards and Pure Materials of American Society for Testing Materials Committee E-2 on Emission Spectroscopy, extends and replaces information given in a publication issued in 1944 by A.S.T.M. and revised in 1947.

The total number of standard samples listed in the new report is 752, comprising 632 spectrographic standards and 120 chemical standards. This total compares with 548 reported in 1947 and 313 in 1944.

The section on pure materials lists 325 entries supplied by 43 sources. The total number of entries of standard samples and pure substances in this report is 1,077, and the various organizations supplying the material are noted. The report is available from the A.S.T.M. as Technical Publication No. 58-B.

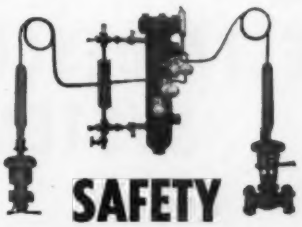
Glycerin Supply Short

NEW YORK.—An increasing number of defense orders for glycerin from all parts of the country and a 3 cent per pound price hike by two leading refiners have caused the overall glycerin-supply situation to become tighter.

Production of synthetic glycerin is to be increased in Texas, but this additional tonnage is not expected to come into the market until the middle of next year. Synthetic-glycerin output by July 1951 is estimated to run at the rate of about 50,000,000 lb. per year, a 15,000,000-lb. increase over present capacity of 35,000,000 lb. annually.

Neodesha Employe Increase

NEODESHA, Kans.—Permanent employes of the Neodesha refinery of Standard Oil Co. (Ind.) will be increased by about 50 per cent within a year, it has been announced by Harry F. Glair, general manager of



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manufacturing and a director of the company.

The personnel increase is in accordance with expansion plans which call for increasing the refinery's crude-run capacity from 10,400 to 19,700 bbl. per day, Glair said. Crude-oil distillation, coking, and rerunning units will be revamped, and new tankage and utilities equipment installed, together with new facilities for improvement of product quality.

Later, it is probable that the company will install a catalytic cracking unit to bring processing facilities of the refinery into complete balance.

Engineering work is under way, and actual construction work is beginning, Glair said. Height of construction activity is scheduled to be reached during the middle of 1951.

Utilities Cut Use of Oil

NEW YORK. — Petroleum refiners are estimating a considerable market loss in gas-enrichment oil due to the entry of natural gas into eastern metropolitan areas. Consolidated Edison Co., operating three gas-manufacturing plants, reports it expects natural gas to replace largely the use of gas-enrichment oil, which it has been using at the rate of approximately 200,000,000 gal. yearly. Refinery marketers anticipate a similar curtailment in other large cities where natural gas is being made available.

Gas-enrichment oil is a specially refined light residual, comparable to No. 5 fuel oil, but with a higher B.t.u. content.

In 1949, Consolidated Edison used 215,000,000 gal. of this oil to manufacture gas. Further reduction in the use of refinery product lies in Consolidated's plan to use natural gas during the summer for powering its generating plant at Hell Gate, Bronx.

This plant has been fueled with No. 6 fuel oil or coal, and will continue by that method during the winter months. Natural gas will be used during the summer to make full use of the 128,000,000 cu. ft. daily which the company is to receive via transmission line. Of the company's three gas-manufacturing plants, those at Hunts Point, Bronx, and at Astoria, Queens, will be converted to use natural gas.

Big October Dividend

WASHINGTON. — Petroleum-refining corporations paid out 25 per cent more in dividends in October than in the same month last year, it was reported last week by the Commerce Department.

The department said that the publicly reported dividend payments amounted to $20,600,000 compared with $16,600,000 in October 1949, bringing payments for the 3 months ending with October to $171,700,000.

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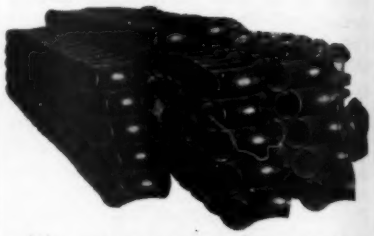

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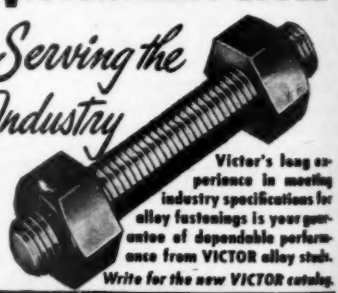

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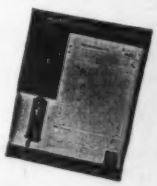

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Among the Drilling Contractors

Elk City Contracts

Contracts have been awarded by Shell Oil Co. for three additional wells in the Elk City field, Beckham and Washita counties, western Oklahoma. Parker Drilling Co., Tulsa, will drill 3-B State, C NW SW 8-10n-21w. Helmerich & Payne, Inc., Tulsa, will drill 4 Cantrell, C NE SE 15-10n-21w; Falcon-Seaboard Drilling Co., Tulsa, will be on 4-B Smith, C NE NE 17-10n-21w.

Drilling Activity Sets New All-Time Record

Drilling activity in the United States and western Canada set a new all-time record during the week ended December 11 when 2,521 rotary rigs were reported in operation. The number of active rigs, an increase of 38 during the week, was 6 greater than the previous peak, reached during the week ended November 20, and 237 more than were reported during the corresponding week of 1949 when the peak for that year was reached.

Operating rigs in the United States alone totaled 2,407, a new record for that region. This number was 16 greater than the November 20 peak. Most important increase during the week was in the Gulf Coast area where 603 rigs were running, the greatest number in that area in 2 years. The Arkansas-North Louisiana-East Texas total was the highest since August 1949. Increases in activity were reported in all areas except West Texas-New Mexico, the Rocky Mountains, and the Pacific Coast.

ROTARY RIGS IN OPERATION*
(United States and Western Canada)

Area—	Week ended 12-11-50	Change week ended 12-4-50	Change week ended 12-12-49
Gulf Coast	603	+17	+ 64
W. Tex.-N. M.	787	— 1	+ 78
Ark.-N. La.-E. Tex.	163	+ 7	+ 4
Oklahoma	309	+13	+ 47
Kansas-Nebraska	161	+ 1	+ 17
Illinois-Eastern	138	+ 3	— 12
Rocky Mountains	114	— 4	+ 24
Pacific Coast	132	— 4	— 16
Total U. S.	2,407	+32	+206
Western Canada	114	+ 6	+ 31
Total	2,521	+38	+237

*Courtesy Hughes Tool Co. Trends in drilling activity in the United States as a whole and in the Rocky Mountain and Western Canada areas are shown by charts on pages 370 and 371.

M. R. Wagner, Cut Bank, Mont., is moving a rig to a wildcat location

Among the many drilling contractors active in the development play in Scurry County, Texas, is J. R. Sharp, Inc., Tulsa. In the accompanying picture are members of one of its crews. They are: Standing, D. W. Suitt, Cass Holland (driller), and C. C. Davis; front row, P. A. Campbell, Dorman Garner, and M. B. Holland.

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18 miles south of the Saskatchewan, Canada, border in northwestern Blaine County, Montana, where he has a contract to drill for Battle Creek Oil & Gas Co. The location is for 1 Holman-Montgomery. It is in the C SW SW 33-35n-19e, on the Battle Creek anticline. Contract is for 300 ft. in the Madison, or 4,700 ft., whichever comes first.

Puckett Drilling Co. is the contractor on a wildcat test which H. E. Hodge & Co. is rigging on a location in the NE NE SE 30-14n-9e, south of the Deep Fork pool, Creek County, Oklahoma. The test, 1 Abraham, is projected to the Bartlesville sand, expected around 2,800 ft., but may be carried to the Dutcher around 3,200 ft.

Sharp Drilling Co., Midland, Tex., has a contract for a 4,500-ft. wildcat test to be drilled for Stanolind Oil & Gas Co. in Section 32, Block 43-1s, T&P Survey, 8 miles south of Odessa, Odessa County, West Texas. Location is for 2 Johnson.

Aggas Drilling Co., Morris, Okla., has taken a contract to deepen a hole abandoned last winter by the former Barnsdall Oil Co. The hole, 1 Busby, SW SE NW 12-4n-8e, northeast of Steedman, Pontotoc County, central Oklahoma, has been taken over by W. H. Pine, who will deepen it from its present total depth of 5,810 ft. in the basal McLish formation to the Arbuckle.

Midwestern Drillers, Inc., Tulsa, has a rig running for Alpine Oil & Royalty Co. at 1 Keeler, SW SW NW 35-20-11, a mile southeast of the South Silica pool, Barton County, Kansas.

Morris & McCutchin, Wichita Falls, have a string of tools working for Frank Wood at 1 King, a projected 4,500-ft. test in Section 2, GB&N Survey, east of the Loving field, Young County, North Texas.

Standard-Fryer Drilling Co., Dallas, is starting a projected 11,000-ft. Ellenburger test for Callery & Hurt in the area 7½ miles north of Stanton, Martin County, West Texas. Location is in Section 18, Block 35-1n, T&P Survey, on the operators' Earl Powell lease.

Nuckolls-Bell Drilling Co., Oklahoma City, is drilling a Cromwell sand test for T. N. Berry & Co. at 1 Bras, SW SW NE 11-13n-9e, east of Welty, Okfuskee County, Oklahoma. The location is 3 miles west of production in the Beidleman-Haydenville district.

Mora Drilling Co. has the contract for a wildcat test which Mid-Continent Petroleum Corp. and Skelly Oil Co. have projected at 1-B Chiles Estate, in the J. Childs Survey, 2 miles northwest of Pottsboro, Grayson County, North Texas. Rig has been moved in.

Heasly & Crumpler Drilling Corp., Houston, has the contract for a 7,500-ft. wildcat test which Gem Oil Co. of Dallas is starting at 1 Hamilton & Deaver, Section 36, Block 19, H&GN Survey, in Collingsworth County, Texas Panhandle. The area is 6 miles northeast of Memphis, Hall County.

M. R. Wagner, Cut Bank, Mont., has contracted for a 3,500-ft. test to be drilled for Carter Oil Co. and Union Oil Co. near Coyote Springs, Glacier County, Montana. Location is for 1 Blackfeet in the C NW NE 35-36n-7w.

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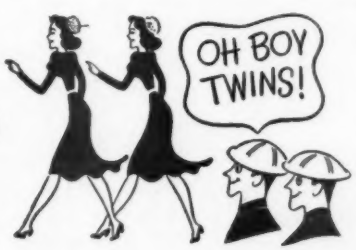

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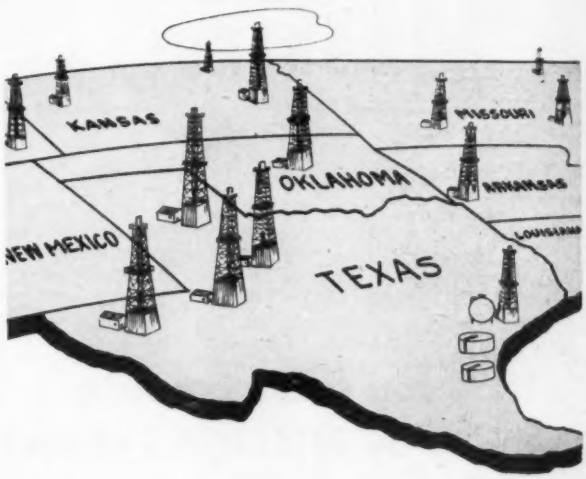

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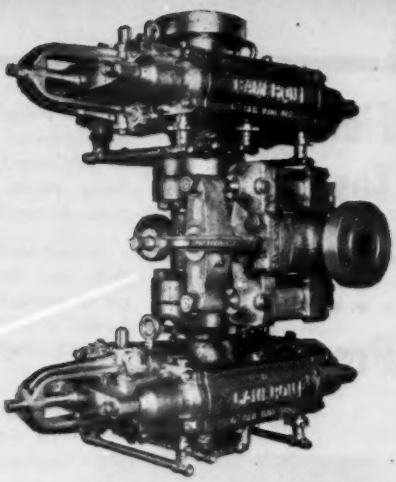

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Exploration and Drilling

Local "Oil Finders" Societies

THROUGHOUT the United States wherever there is a concentration of oil-exploration scientists will be found a local section of the American Association of Petroleum Geologists and/or the Society of Exploration Geophysicists.

These local sections were formed to promote the science of oil exploration by discussions of interest to the membership on a down-to-earth basis at a place where attendance at frequent meetings would be possible. These societies are the proving ground for new ideas and the clearing house for results of research. Their discussions, at planned meetings or "between acts," give birth to new ideas to be tried and, if worth while, to be reported to in turn start other new ideas.

An excellent example of a new idea resulting from a local meeting is the one regarding the use of a seismograph for locating sandbars. *(The initial application and a simplified explanation for this new idea was reported on page 141 in the October 26 issue of The Oil and Gas Journal.)*

Nearly 2 years ago at one of the weekly luncheons of the Tulsa Geological Society, a paper on the geology of South Ceres "shoe string" sand pool of north-central Oklahoma was presented. Among other things this paper pointed out that a thin limestone member, slightly higher in the section than the producing sandbar, formed an unmistakable ridge or long narrow nose throughout the length of the pool.

A geophysicist at this meeting asked himself: "Could a seismograph do any good in predicting the course of the bar by mapping this ridge?" Why, the idea was absurd. How could a seismograph, which can be so wrong when trying to locate small differences in elevation, pick up a narrow ridge with a slight (say 20 ft.) relief? With this question in mind an unconventional approach to the problem was conceived and developed.

The idea was checked in a drilled area of South Ceres. Not only was the ridge picked up, but a false low beneath the bar was indicated. Somebody remembered some old experiments which showed a decided decrease in the velocity of sound in sandstones as water saturation was increased. Here were facts that could account for the apparent syncline beneath this oil-bearing, and therefore water-bearing, sand lens. The theory must have merit.

After more encouraging checks, a location was recommended in a then unknown extension area of South Ceres. A producer was brought in. More recommendations followed—more producers. Then it happened—a dry hole. That's all it took to convince some people that there was nothing to the system. But, top geophysicists don't feel that way. They feel that the idea may well prove sound and practical and that it deserves the utmost attention. They see a new approach to the old problem of how to locate porosity traps by less luck-requiring means than random drilling. Let's hope they are right because a major portion of this country's undiscovered reserves is believed to occur in such traps.

The producers in South Ceres pool indicate a long (now 9 miles), narrow (1,000 ft.) sandbar. Take a look at the big sandbars in existence today. They don't run like that forever. They curve and twist and are cut by inlets and stream channels. The wells at the north end of South Ceres indicate that this bar may not be restricted as it appears in the south. Is it going to take random drilling to locate the extent of this oil-bearing bar? Or, will the art of bar hunting with a seismograph be given a chance to develop and prove that those who have faith in the new idea are right?

Other ideas have been born at local society meetings. The better ideas met with disagreement. They were questioned and fought, but they were also worked on by those who added new ideas and twists. The final result: a new approach in the search for oil—with any resemblance to the original idea, purely coincidental, perhaps.

The idea that sandbars can be located by seismograph was presented to the Geophysical Society of Tulsa last week. The basic theory of the method was given to the industry so that the approach could be "cussed" and discussed, studied, altered, developed, improved, and applied until general agreement of its true worth is obtained. *Philip C. Ingalls.*

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

WEST TEXAS.—Third pay, San Andres, has been opened in the Diamond M field at Hiawatha Oil & Gas Co. 9 Wilson, 183-97-H&TC. The well made a small pumper of 33°-gravity oil from 2,380-2,420 ft. and 2,438-58 ft. C. W. Murchison 1 Joe Cannon, Midland County wildcat, recovered 1,500 ft. of free oil from the Ellenburger at 13,100-52 ft. Top of the zone at minus 10,240 ft. was said to be 127 ft. low to nearest producer, but figured 138 ft. above the water table in Pegasus field. Sinclair and Magnolia 1 Davis swabbed and headed 86 bbl. of fluid, mostly oil, in 24 hours from perforations at 13,165-90 ft.

NORTH TEXAS.—Northwest of Boedecker Viola lime field, An-Son Petroleum 1 Foster completed as a conglomerate oil discovery with calculated daily potential of 520 bbl.

SOUTHWEST TEXAS.—Full evaluation of the Edwards lime is being made at Lone Star Producing Co. 1 Sarah E. Ferry, I&GN Survey, Abstract 431, Atascosa County wildcat. Drill-stem test run at 8,198-210 ft. recovered 120 ft. of rathole mud, 30 ft. of oil, and 30 ft. of heavily oil and gas-cut mud. In McMullen County, Delhi Oil Corp. has an indicated gas-distillate discovery from the Wilcox at its 1 D. W. Rhodes, F. M. Drake Survey 78, Abstract 867. Drill-stem test run from 7,313-24 ft. recovered 15 ft. of distillate and 15 ft. of distillate-cut mud.

KANSAS.—The first shows of consequence ever found below the Mississippian in southwestern Kansas were encountered in the Viola at Stanolind Oil & Gas Co.'s 1 Wall, Clark County test.

Southwest Texas

Lone Star Studying Edwards Lime in Atascosa Test

CORPUS CHRISTI.—At its deep Atascosa County wildcat, Lone Star Gas Producing Co. is making full evaluation of the Edwards lime horizon in its 1 Sarah E. Ferry, I&GN Survey, Section 1,699, Abstract 431. Latest drill-stem test was taken of the interval 8,198-210 ft. using ¼-in. chokes. The well recorded an immediate good blow of air and continued through the test. Recovery was 120 ft. of rat-hole mud, 30 ft. of oil, and 30 ft. of heavily oil and gas-cut mud. Operators are currently pulling a core which was taken from the interval 8,210 ft.

Delhi Oil Corp. has an indicated gas-distillate discovery from the Wilcox at its 1 D. W. Rhodes, F. M. Drake Survey 78, Abstract 867, 5 miles north of Brazil in McMullen County. Top of the Wilcox was called at 7,313 ft. A 7-minute drill-stem test was run from 7,313-24 ft., with recovery being 15 ft. of distillate and 15 ft. of distillate-cut mud. Working pressure was 500 psi. Core from 7,311-40 ft. had a recovery of approximately 25 ft. of effective gas-distillate sand in the Wilcox zone. A drill-stem test from 7,340-45 ft. recovered salt water. Operator is now coring ahead below 7,553 ft. in the Wilcox.

After failing to pick up the sand bodies productive in the Dilworth field wells, Ryan, Hays & Burke are now swabbing from the Sandy Reklaw at 1 George Sealy Estate, wildcat test 5,100 ft. northwest of other production in the field, McMullen County. The Sandy Reklaw was perforated at 3,262-68 ft., and latest swab record was 15 per cent oil and 85 per cent water. The perforated section is immediately below the Carrizo section. The well is located in Juan I. Diaz Survey 41, Abstract 176.

Potential test has been run on Rudco Oil & Gas Co. 1 Yturria Land & Livestock Co., oil discovery in Porcion 100, Starr County. The well was gaged for 84 bbl. of 45.9°-gravity oil per day on pump. Production is through perforations at 4,092-102 ft.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) SUCCESSFUL WILDCATS

San Patricio County: Oil discovery "Rudco"—Rudco Oil & Gas Co. 1 Yturria Land & Livestock Co., Porc. 100, 4 mi. NW of Sullivan City, TD 6,011 ft., top pay 4,092 ft., perf. 4,092-102 ft., IP 84 bbl. oil per day, 45.9° gravity.

Travis County: Oil discovery "Elroy"—Anderson-Prichard Oil Corp. 1 Albin C. Jacobson, Michael Green Sur., 1½ mi. E of Elroy, TD 836 ft., completed from open hole in Serpentine at 814-36 ft., IP: 26 bbl. oil per day on pump, 34° gravity.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) WILDCAT FAILURES

Duval County: James M. Anderson & Geo. Parker, et al, 1 Duvan County Ranch Co., BS&F Sur. 575, A-151, dry, TD 4,260 ft.

Chicago Corp. 1 S. Benavides, El Mesquite Gr., 12½ mi. S-SW of Realitos, dry, TD 3,510 ft.

S. C. Dunlap, et al, 1 Johnny Brooker Stegall, SE&MG RR Sur. 1, A1531, dry, TD 2,509 ft.

Frio County: Gasoline Production Corp., et al, 1 W. W. Bueche, J. Massey Sur., A-1,212, dry, TD 4,148 ft.

Humble Oil & Refining Co. 1 Oppenheimer & Lange, Henry Castro Sur. 55, A-261, dry, TD 5,800 ft.

Milam Drilling Co. 1 S. J. Williams, Jr., TCRR Co. Sur. 5, A-981, dry, TD 6,130 ft.

Gonzales County: United North & South Development Co. 1 Albert Saefje, Jose de la Baume Sur., 3 mi. SW of Belmont, dry, TD 4,050 ft.

Hidalgo County: Taylor Refining Co. and Mayfair Minerals, Inc., 1 Kells Elvin, J. C. Kelly Subd., Share C, Porc. 69, dry, TD 10,824 ft.

Jim Hogg County: O. W. Killam 1 R. Holbein, Las Animas Gr., A-244, 17 mi. SE of Mirando City, dry, TD 4,084 ft.

V. G. Schimmel, et al, A-2 Julian Vela Pena, Block 71, Sur. 574, 15 mi. SW of Hebbronville, dry, TD 1,820 ft.

Kendall County: Kendalia Co., Inc., 1 C. & H. Seidensticker, Antonio Rodriguez Chacon Sur. 257, 17 mi. NE of Boerne, dry, TD 1,600 ft.

McMullen County: Hassie Hunt, Trust, Estate, 1 Robert Poenisch, G. C. Palacios Sur. 32, A-1,074, dry, TD 7,027 ft.

San Patricio County: Commercial Petroleum & Transport Co. 1 H. G. Richie, Lot 6, Sec. 40, 4th Subd. of Faft Farm Lands, 9 mi. NE of Taft, dry, TD 9,019 ft.

Webb County: Magnolia Petroleum Co. 1 Chan Cullers, Block 2, CCSD&RGNG Sur. 204, 13 mi. N of Oilton, dry, TD 2,983 ft.

Harry E. Murray 1 Mrs. E. W. Dobie, Sur. 28, 25 mi. NW of Freer, dry, TD 1,916 ft.

Texas Gulf Coast

New Wilcox Discovery in Lavaca County Completed

HOUSTON.—After considerable delay due to flow-line freezing, Horrigan & Fohs have completed 1 Rosie Martisak, et al, John Morris Survey, Abstract 303, for a new Wilcox discovery in Lavaca County. On 24-hour test through ⅛-in. choke, the well flowed 924,000 cu. ft. of gas per day and 74 bbl. of 54°-gravity distillate. Tubing pressure was 2,525 psi. Well is bottomed at 9,906 ft. and production is through perforations at 9,396-736 ft.

The Texas Co. is at total depth of 8,868 ft. and is running 7-in. casing for production tests at 1 Sallie Ragsdale, A. J. Davis Survey, wildcat test in Bee County. Interval to be tested is not known, but several intervals in the well indicated commercial shows. On drill-stem test at 7,887-93 ft., recovery was 5 gal. of 46°-gravity oil, 658 ft. of clear water, and 188 ft. of muddy fresh water. Drill-stem test from 8,062-73 ft. recovered 200 ft. of oil-cut mud and approximately 150 ft. of 29°-gravity oil.

Quintana Petroleum Corp. has completed 1-B Henderson & Pickering, A. B. Williams Survey, Abstract 353, wildcat test 3 miles northwest of Placedo in Victoria County. The discovery flowed an estimated 180 bbl. of 47°-gravity oil per day through ¼-in. choke. Interval tested was 6,852-55 ft. Due to salt-water flow, perforations were squeezed and a test of the squeeze job recovered 5 bbl. of fluid per hour, being 65 per cent oil. Perforations were resqueezed and section was reperforated and completed at 6,852-55 ft. On final test, the well was gaged for 125 bbl. of 48.3°-gravity oil per day through 9/64-in. choke.

Cores of the second Massive sand section recovered some oil shows in Frank W. Michaux 1 Kauffman Estate, George Southerland Survey, 2 miles south of Charco. Drill-stem test was run, but no details are available on recovery; however, it is believed that the test was not too encouraging as the sand was reported tight. Commercial production from the Luling zone at 7,677-88 ft. was indicated on drill-stem test, with recovery being gas-distillate.

TEXAS GULF COAST (DISTRICTS 2 AND 3) SUCCESSFUL WILDCATS

Goliad County: Oil discovery, "West Terrell Point"—Paul J. Fly, et al, 1 Lula Swickheimer, et al, W. P. Patterson Sur., A-325, 5 mi. SE of Fannin, TD 4,863 ft., perf. (Basal Frio) 4,656-64 ft., IP: 135 bbl. oil per day, 26.4° gravity.

Hardin County: New pay at Batson—L. D. Cain 1 Marrs McLean, F. H. Green Sur., A-24, TD 6,314 ft., perf. 6,203-34 ft., IP: 157 bbl. oil per day, 9/64-in. choke, 38.5° gravity.

Jefferson County: New pay at Big Hill—Glenn H. McCarthy B-1 W. D. Davidson Estate, J. E. Broussard Sur., A-483, N flank of Big Hill dome, TD 11,417 ft., perf. 8,424-32 ft., IP 214 bbl. oil per day, ½-in. choke, 40° gravity.

Tyler County: Oil discovery—Stanolind Oil & Gas Co. 5 James F. Parker, et al, Geo. T. W. Collins League, TD 9,005 ft., top pay 8,513 ft., perf. 8,532-42 ft., IP: 80 bbl. oil per day, 46° gravity.

Washington County: Oil discovery—Edwin L. Cox & Jake L. Hamon 1 Bessie T. Hughes, E. R. Miller & W. R. Munson Leagues, 5 mi. N of Chapel Hill, TD 9,712 ft., top pay 9,364 ft., perf. Wilcox 9,365-69 ft., IP: 241 bbl. oil per day, 36° gravity.

TEXAS GULF COAST (DISTRICTS 2 AND 3) WILDCAT FAILURES

Brazoria County: The Texas Co. 1 Mrs. Holly B. Perry, S. F. Austin ½ League, 2½ mi. N of Velasco, dry, TD 5,755 ft.

Chambers County: The Texas Co. 1 State Tract 9-12C, Trinity Bay, 7 mi. SW of Anahuac, dry, TD 9,200 ft.

Jefferson County: H. L. Hunt 1 George C. O'Brien, M. Chirino Sur., A-10, dry, TD 8,776 ft.

San Jacinto County: Commercial Petroleum, et al, 1 Ellisor-Kirby Estate, Vital Flores Sur., A-14, dry, TD 4,610 ft.

Waller County: J. P. Petkas 1 J. G. Kellner, John McFarland Sur., A-46, 3 mi. W of Brookshire, dry, TD 3,727 ft.

Wharton County: R. E. Hibbert 1 Ben Kubena, Thos. Slaughter Sur., A-59, dry, TD 4,965 ft.

S. W. Richardson, et al, 1 P. Rolf, et al, M. Weiss Sur., Sec. 16, A-556, dry, TD 6,749 ft.

Ryan Consolidated Petroleum Corp. 1 Rudolph Holub, ET RR Co. Sur. 37, A-112, dry, TD 7,158 ft.

Eastern Texas

Town-Lot Drilling Gets Setback at Lott Townsite

DALLAS.—Town-lot drilling had a temporary setback this week at E. Fletcher 1 Conally Gwyn, Buda limestone exploration on the south side of the Lott townsite. According to reports, casing collapsed when plug was drilled out at 1,330 ft. Operators were to move 50 ft. east to drill the 1-A Gwyn rather than attempt to salvage the old hole.

Arkansas-Louisiana Gas Co. 1 Furrh Estate, R. Mitchell Survey, was showing for an extension to the oil-producing area of the Waskom field. Operator's seventh core, not identified but apparently in the Travis Peak, from 6,207-55 ft. recovered 48 ft., being 9 ft. of shale and sandy shale, 2 ft. of fine sand, 6 in. of black shale, 5 ft. of sand with spotted oil stains, 9 ft. of sandy shale, 14¼ ft. of slightly porous sand with good oil stains and odor, 2 ft. of black shale, 2 ft. of sand bleeding oil and 5 ft. of black shale. It was said to be the first core with oil shows.

A 20-minute drill-stem test between 6,219-55 ft. recovered 1,200 ft. of oil, 120 ft. of oil and gas-cut mud and 90 ft. of brackish water. Bottom-hole flowing pressure was 500 psi.

Testing continued at Stanolind Oil & Gas Co. and Continental Oil Co. 1 Griffis unit, possible Pettit lime extension to the Woodlawn field. The middle Pettit section was described as tight and plans were to use further acid. Reports indicated shut-in pressures had built up as high as 2,100 psi. but would drop to as low as 150 psi. after flowing for a few hours. Same operators' 1 G. H. Sanders, indicated north extension to the field, prepared to run pipe and try for completion after making electrical survey. Total depth was 6,561 ft.

EAST TEXAS (DISTRICTS 5, 6 AND 6-P) WILDCAT FAILURE

Limestone County: Albert L. Renberg 1 George M. Tidwell, Pedro Barela Sur., 10 mi. SW Mexia, dry, TD 920 ft.

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FIELD PROVEN

North Central Texas

Canyon Sand Discovery Completed for 66 Bbl.

WICHITA FALLS.—Rowan & Hope 1 City of Sweetwater, Nolan County, Canyon discovery 8 miles south of Sweetwater, completed this week for a flowing potential of 66 bbl. of 41°-gravity oil. The flow was gaged through ¾-in. choke, from pay at 5,242-5,302 ft.

Sun Oil Co. 1 Parramore, southwest Nolan County wildcat, acidized the Pennsylvanian formations through perforations at 7,011-21 ft. and prepared to test.

In Montague County, northwest of the Boedecker field, An-Son Petroleum Corp. 1 B. L. Foster completed as a conglomerate discovery. The well topped the conglomerate around 6,059 ft. and on the second dirll-stem test had flowing oil. First test from 6,059-79 ft. had oil at the surface but recovery and flow, if any, was not disclosed. Second test from 6,080-98 ft. flowed oil in 11 minutes, with no estimate or gage, and third test through perforations in pipe at 6,079-99 ft. kicked off and flowed 168 bbl. of 47°-gravity oil in 5 hours through ¼-in. choke, under flowing pressures of 825 psi. on tubing and 1,000 psi. on casing. Initial potential was 130.5 bbl. of oil in 6 hours through ¼-in. choke, for a calculated daily rate of 520 bbl. An-Son has a block of some 1,200 acres around the discovery. According to reports, Magnolia Petroleum Co. was laying a pipe line to the new well.

Twelve miles north of Throckmorton, Drilling & Exploration Co.'s 1 Richardson Trust had discovery production from the Caddo lime topped at 4,526 ft. First test at 4,526-38 ft. had gas in 4 minutes and flowing oil in 11 minutes, estimated at the rate of 15 bbl. an hour. Final recovery was 1,450 ft. of free oil.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) SUCCESSFUL WILDCATS

Clay County: C. U. Bay 1 R. S. Thompson, Blk. 7, Graves Subd., Orange CSL, 4½ mi. SW Henrietta, TD 5,954 ft., elev. 952 ft., Mississippian pay 5,945 ft., flowed 149.9 bbl. 42°-gravity oil a day.

Coleman County: H. R. Burden 3 P. J. Reeves, B. Ferguson Sur. 743, 3 mi. S Coleman, TD 2,331 ft., elev. 1,677 ft., pay sand 2,325 ft., pumped 18.8 bbl. 40°-gravity oil a day.

Cooke County: J. R. and Adam Seitz 1 E. H. Dove, H. Coffee Sur., A-223, 6 mi. SE Woodbine, TD 3,677 ft., perf. sand 3,253-63 ft., pumped 45 bbl. 18°-gravity oil a day.

Eastland County: I. Weiner 1 Ted Hale, 42-4-H&TC, 5 mi. NE Cisco, TD 1,680 ft., elev. 1,511 ft., perf. sand 1,612-22 ft., flowed 168 bbl. 40°-gravity oil a day, ¼-in. choke.

Jack County: Forest Oil Corp. and Streeter Oil Co. 3 Lewis & W. R. Johnson, Rebecca Parker Sur., 2 mi. NE Antelope, TD 2,129 ft., elev. 991 ft., oil sand 2,125-28 ft., pumped 14.3 bbl. 37°-gravity oil a day.

Nolan County: Sun Oil Co. 1 S.. R. Featherstone, 38-X-T&P, 10 mi. SE Sweetwater, TD 6,192 ft., perf. Strawn 6,168-92 ft., pumped 22.5 bbl. 41°-gravity oil a day.

Young County: Mid-Continent Petroleum Corp. 1 C. B. Daniels, 420-A-627-TE&L, 2½ mi. SE Newcastle, TD 4,673 ft., elev. 1,217 ft., Mississippian pay 4,660 ft., flowed 393 bbl. 42°-gravity oil a day.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) WILDCAT FAILURES

Archer County: Frank Wood 1 B. H. Fichte, Blk. 23, Meade Pasture Subd., 2½ mi. NE Margargel, dry, TD 1,555 ft.

Baylor County: J. J. Lynn 3-B Claude Cowan, T&NO Sur., 10 mi. E Seymour, dry, TD 5,261 ft.

R. Clay Underwood 1 H. N. Brown, 49-45-H&TC, 2½ mi. S Bomarton, dry, TD 1,555 ft.

Brown County: B. H. Nolen and H. O. Newman 1 Edd Hall, J. D. Page Sur., 1½

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Note in the above illustration how the WeldOlet tapers to provide a single bevel groove joint at the crotch section and blends into a V-butt joint at the ear portion.

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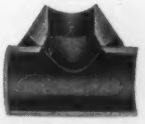


Fig. 1—Cut-away view of reducing size WeldOlet with welding outlet in place. The external rib and wide bases or footings of WeldOlets eliminate the need for extra supports to take care of bending or vibrational stresses at crotch section, the point of greatest stress.

Fig. 2—Note blending of ear portion of welding fitting to run pipe. Extension of weld metal below inside scarfed portion of pipe insures all sections of joint greater than pipe wall thickness.

mi. SW Brownwood, dry, TD 2,007 ft., elev. 1,518 ft., Marble Falls 1,712 ft.

Callahan County: N. M. Dillard 1 C. E. Foster, Uriah Bass Sur., 12 mi. NE Cross Plains, dry, TD 765 ft.

United North & South Development Co. 2 J. T. Edwards, Sec. 18, BBB&C Sur., 9 mi. SW Clyde, dry, TD 4,420 ft., elev. 2,021 ft., Caddo 4,175 ft.

Clay County: J. B. Palmer 1 Schnabel & Dowlen, Blk. 160, Byers Bros. Subd., 3 mi. NW Byers, dry, TD 1,875 ft.

Coleman County: Anzac Oil Corp. 1 J. E. Folk, 1-57-Coleman CSL, 5 mi. SE Coleman, dry, TD 2,136 ft., elev. 1,757 ft., Jennings sand 2,132 ft., Fry 2,091 ft.

Joe Stelzig 1 Otis Bivins, Wade H. Bynum Sur., 2 mi. SW Santa Anna, dry, TD 2,160 ft., Breneke sand 1,774 ft.

Westates Oil & Royalty Co. 1-B Theo Griffis, J. A. H. Peoples Sur. 295, 7½ mi. SW Coleman, dry, TD 1,263 ft.

Coryell County: M. C. Susman 1 C. E. Gotcher, J. J. Allbritton Sur., 3 mi. SW Coppers, dry, TD 1,450 ft.

M. C. Susman 1 John Hersog, James A. Acklin Sur., 4 mi. NW Coppers Cone, dry, TD 2,750 ft.

Haskell County: Continental Oil Co. 1 Willie Z. Bettis, 192-45-H&TC, 5 mi. NW Weinert, dry, TD 6,043 ft., elev. 1,545 ft., Strawn 4,543 ft., KMA sand 4,836 ft., Caddo 5,491 ft., Mississippian 5,491 ft., Ellenburger 6,007 ft.

Jack County: Midland Oil Corp. 1 Fred A. Gray, W. M. Wood Sur., 1½ mi. SW Bartons Chapel, dry, TD 4,648 ft.

Jones County: S. C. Herring 1 E. D. Apperson, 105-1-BBB&C, 8 mi. NE Hamlin, dry, TD 3,248 ft.

Montague County: Ted A. Norwood 1 Arch Durham, W. J. Wagnon Sur., 5½ mi. NE Bonita, dry, TD 1,702 ft.

Ted Weiner 1 W. A. Hodges, B. McGaha Sur., 4 mi. N Nocona, dry, TD 5,320 ft., granite wash 5,110-60 ft.

Stonewall County: Bridwell Oil Co. 1 J. M. Alexander, Sec. 6, Austin & Williams Sur., 6 mi. N Hamlin, dry, TD 5,450 ft., elev. 1,762 ft., KMA sand 5,269 ft., Strawn sand 5,336 ft.

Throckmorton County: W. E. Bakke 1 S. H. Cain, Sec. 1,632, TE&L Sur., 7 mi. S Throckmorton, dry, TD 4,885 ft., elev. 1,390 ft., Breckenridge lime 1,172 ft., Ranger 2,126 ft., Palo Pinto 2,626 ft., Caddo 4,247 ft., Barnett shale 4,763 ft.

Bridwell Oil Co. 3 R. P. Lee, Sec. 198, BBB&C Sur., 5½ mi. SW Throckmorton, dry, TD 4,771 ft., Palo Pinto 2,968 ft.

Ohio Fields

New Castle Township Pool Work Holds Limelight

COLUMBUS.—New Castle Township, Coshocton County, pool is providing the best wells being drilled in at this time. Willard Shrider et al 2 Perry Richards made a good showing natural and swabbed 130 bbl. in 24 hours after shot. The Clinton was logged at 3,238-96 ft.

Pure Oil Co. 1 Perry Richards made 65 bbl. in 2½ days while drilling in, and made an estimated 100 bbl. in 24 hours after shot. Preston Oil Co. 2 Bertha Barrett made 10 bbl. natural, but failed to respond to the shot and will be cleaned out and reshot.

Ohio Fuel Gas Co. 1 W. H. Siegenthaler, Section 9, Prairie Township, Holmes County, ⅛ mile east of 1 Pyers, found the upper Clinton dry at 3,322-42 ft., and 625,000 cu. ft. of gas in the lower sand at 3,365-80 ft. The well will be tubed natural.

Burtner, Morgan & Stephens 1 E. R. Eberhart, Section 18, Lawrence Township, Tuscarawas County, a 1½-mile northeast stepout, gaged 350,000 cu. ft. in the Red Clinton at 4,740-71 ft., and 375,000 cu. ft. in the White at 4,789-4,803 ft.

Permian Basin

More Gas-Distillate Is Assured South of Benedum

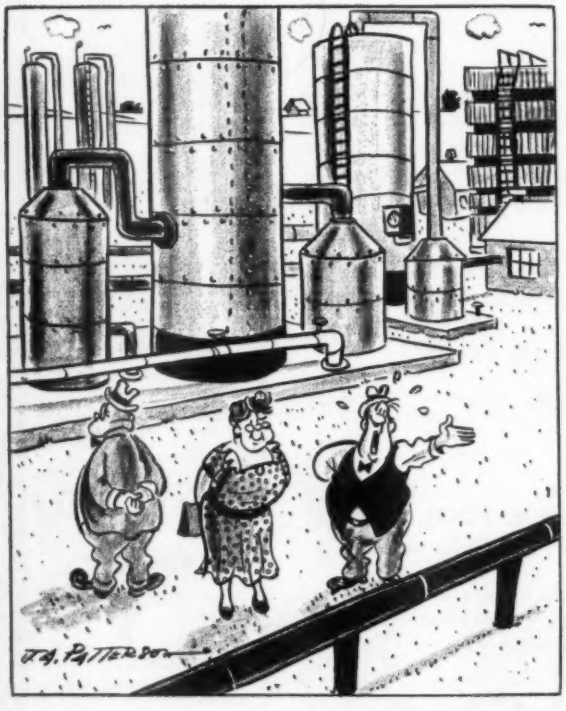
MIDLAND.—Cities Service Oil Co. and Continental Oil Co. have been definitely assured of additional gas-distillate pay at their 1-AH University, Upton County wildcat 6 miles south of the Benedum area.

History of the well included a flow of 10-20 bbl. of oil hourly on a drill-stem test in Spraberry sand from 7,128-85 ft.

First production of distillate from the Ellenburger was on a 2-hour test from 10,724-755 ft., which made a flow of 166 bbl. of 57°-gravity oil. Drilled ahead to 10,805 ft., first test, using 2,000 ft. of water blanket, recovered the water cushion and 180 ft. of gas-cut mud with a light show of distillate. During the 1½-hour test the tool was opened and closed several times. Operators reported the tool had plugged. Second test had about the same results.

Third test, at the same interval, with 3,000 ft. of water blanket, started flowing the water in 7 minutes and oil and gas in 13 minutes. It was flowed into pits for 5 minutes then turned into tanks where it gaged 30.6 bbl. of 61°-gravity distillate the first 17 minutes, with gas rated at 5,683,000 cu. ft. per day. The next three 30-minute gages were 60.1, 55.9, and 45.9 bbl. of distillate, giving it an average flow during the test of about 111 bbl. per hour. Average gas-oil ratio was 1,984 cu. ft.

In northwestern Upton County, Magnolia Petroleum Co. and Sinclair Oil & Gas Co. were still trying to make a well at their 1 Davis. The Ellenburger, through perforations from 13,165-190 ft., was being tested and at last report the well was swabbed



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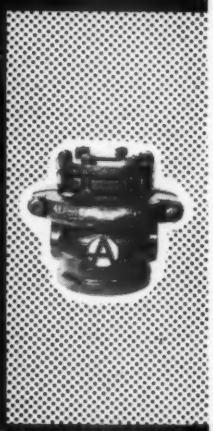

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and flowed for 137 bbl. of oil plus 51 bbl. of water in 24 hours.

Gulf Oil Corp. 1-E TXL "SS" in Section 20-38-T&P, southwest outpost to the Pegasus field, Upton County, had flowing oil in 10 minutes on a test from 10,243-314 ft., cleaned into pits for 38 minutes, then flowed 168 bbl. of clean, 50°-gravity oil in 3 hours. Second test from 10,269-354 ft. again had oil in 10 minutes and gaged 56 bbl. of oil in 1 hour, which tested 44.7° gravity. Gas-oil ratio was 1,859 cu. ft. Recovery was reversed out.

Benson & Montin, Inc. 1 Josie Faye Peck, 20-14-T&P, opened Fusselman pay in the Peck field of Midland County, and was completed from both the Fusselman and the Ellenburger. Potentials were 240.73 bbl. of 50°-gravity oil from Fusselman perforations at 12,505-555 ft., flowing through 12/64-in. choke, and 731 bbl. of oil a day from the Ellenburger at 13,160-300 ft.

Continental Oil Co. 2 Swenson, Garza County Reef prospect, was drilling ahead at 7,094 ft. in lime following two additional tests which added some possibilities to the pay section. First production was recovery of 1,260 ft. of clean oil at 6,835-62 ft., tentatively identified as reef formation. Second test from 6,850-87 ft., open 5 hours and 25 minutes, reversed out 1,800 ft. of oil, with no water. There was 90 ft. of salty drilling mud on bottom. Third test open 2 hours from 7,024-43 ft. recovered 105 ft. of oil and gas-cut mud, plus 60 ft. of salt water. The project was originally scheduled to 8,600 ft.

Wilshire Oil Co., Inc. 1 Augusta Brownfield, Terry County wildcat about 4½ miles northeast of the South Brownfield Canyon reef field, had found no shows and no solid limestone in the Pennsylvanian and operators were to drill ahead to the Ellenburger.

At last report drilling was below 10,290 ft., in the Pennsylvanian, which was said to be 90 per cent shale and 10 per cent lime. Tentative top on the formation was 10,109 ft.

Spraberry operations are holding strong in and around the Tex Harvey field of Midland County, with one extension completed this week, a new pay opened, and offsets staked to the recent extension well to the east in Glasscock County.

North extension to the field was Ted 1-4 M. H. O'Daniel, which made potential of 375 bbl. of clean oil from pay between 7,000-7,265 ft.

New pay opener was George and Frank Frankel 3-C Floyd, field extension and first to complete in the upper Spraberry sand. Top of the sand and pay was 7,071 ft., minus 4,422 ft. and potential was 319 bbl. of 36°-gravity oil a day through 24/64-in. choke. Total depth was 7,138 ft.

WEST TEXAS (DISTRICTS 8 AND 7-C) SUCCESSFUL WILDCATS

Dawson County: Standard Oil Co. of Texas 1 Mrs. M. V. A. Smith, 34-C41-PSL, 4 mi. SW O'Donnell, TD 9,685 ft., lower Spraberry pay 7,940 ft., flowed 73 bbl. 37°-gravity oil a day.

Ector County: Texas Gulf Producing Co. 1 Woodward, 9-45-2S-TUP, TD 8,440 ft., elev. 3,112 ft., perf. Tubb 6,158-6,285 ft., flowed 438 bbl. 40°-gravity oil a day.

Kent County: General American Oil Co. 1 R. L. Spires, 10-4-H&GN, 1½ mi. NW Spires field, TD 7,227 ft., elev. 2,064 ft., Strawn perf. 6,880-6,903 ft., pumped 149 bbl. 36°-gravity oil a day.

King County: Humble Oil & Refining Co. 69 Bateman Trust, 133-A-J. B. Rector Sur., 11½ mi. E Guthrie, TD 5,324 ft., elev. 1,735 ft., Strawn pay 5,310 ft., flowed natural 136 bbl. 37°-gravity oil a day.

Pecos County: P. L. Crandell 1 Iowa Realty Trust, 9-10-H&GN, 4 mi. W Pecos HG field, TD 1,113 ft., open hole 940-1,113 ft., pumped 107 bbl. 27°-gravity oil a day.

WEST TEXAS (DISTRICTS 8 AND 7-C) WILDCAT FAILURES

Borden County: C. W. Guthrie 1 V. H. Wolfe, 40-25-H&TC, 4 mi. NW Vincent field, dry, TD 4,247 ft., elev. 2,329 ft.

H. L. Hunt 3-B Clayton & Johnson, 16-31-6N-T&P, 1 mi. NW Spraberry pro-

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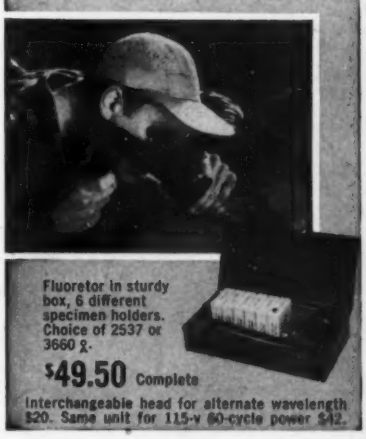

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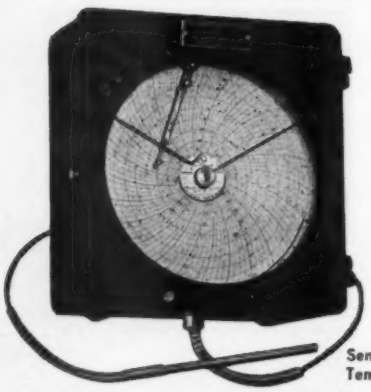

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duction, dry, TD 9,294 ft., elev. 2,760 ft., Spraberry 5,895 ft., Canyon lime 8,240 ft., reef 8,290 ft., Strawn 8,400 ft., Mississippian 8,500 ft., Ellenburger 8,975 ft.

Crockett County: R. W. Fair 1 University "46," 26-46 University Lands, 3½ mi. W Midway Lane field, dry, TD 1,878 ft. James H. Snowden 2 Hugh Andrews, 43-UV-GC&SF, 15 mi. NW Ozona, dry, 1,979 ft., elev. 2,643 ft.

Kent County: Seaboard Oil Co. et al 1 Girard Trust, 9-1-H&GN, 2½ mi. N Salt Creek field, dry, TD 7,440 ft., elev. 2,037 ft., reef 6,590 ft., Ellenburger 7,406 ft.

King County: Tide Water Associated Oil Co. 1-C Pitchfork Ranch, Sec. 269, John Gibson Sur., 8 mi. NW Guthrie, dry, TD 6,780 ft., Pennsylvanian 4,720-70 ft., Mississippian 6,750 ft.

Midland County: Lynn Durham 1 M. E. Turner, W. T. Holcombe Sur., 2 mi. N Tex Harvey field, dry, TD 7,470 ft., elev. 2,669 ft., Spraberry 7,230 ft.

SOUTHEAST NEW MEXICO

HOBBS.—Magnolia Petroleum Co. 1-B C. L. O'Brien, Chaves County wildcat 9 miles southwest of the Lightcap discovery, also by Magnolia, completed for a daily flowing potential of 270 bbl. of 54°-gravity oil through ¼-in. choke. Pay zone is the Devonian from 7,253-59 ft.

In northeastern Lea County, McAlester Fuel Co. 1 Lulu Simpson, 1-mile northeast stepout from the same company's 1-A Brownfield, Devonian discovery of the Gladiola field, had flowing oil in 51 minutes on a drill-stem test in the Wolfcamp from 9,751-69 ft., and in 1 hour flowed 41 bbl. of 43°-gravity oil. Drill pipe unloaded most of the way out.

A new exploration for northwestern Lea County has been scheduled by H. S. Moss, Dallas, as the 1 State in SW SW 32-11s-33e. The 10,750-ft. wildcat will seek Devonian pay. Location is about 2 miles west of Amerada Petroleum Corp. 2 Caudle, indicated northwest extension to the Bagley Pennsylvanian field.

Ralph Lowe 1 Dickinson, 35-14s-37e, completed for a flowing potential of 960 bbl. of 44°-gravity oil daily, through 20/64-in. choke, from open hole pay at 12,360-385 ft., to extend the Denton Devonian field about 2 miles north. Flowing tubing pressure ranged from 850-890 psi. Skelly Oil Co. will drill the south offset to the 1 Dickinson, according to field reports.

SOUTHEAST NEW MEXICO SUCCESSFUL WILDCAT

Eddy County: Martin Yates, Jr. 1 Featherstone-State, 32-19s-27e, TD 361 ft., pay 349 ft., pumped 50 bbl. 35°-gravity oil a day.

SOUTHEAST NEW MEXICO WILDCAT FAILURE

Chaves County: John W. Sanders 1 Sanders, 25-5s-24e, dry, TD 5,355 ft., elev. 3,872 ft., San Andres 780 ft., Glorietta 1,470 ft., Yeso 1,550 ft., Abo 3,690 ft.

South Louisiana

Williams Wildcat at 9,000 Ft.; Shows Logged in Wilcox

NEW ORLEANS.—Three miles northwest of Glenmore field, Rapides Parish, Harry B. Williams 1 J. B. Edwards, et al. 16-1s-2w, wildcat, is at total depth of 9,000 ft. Electrical survey was run to 8,500 ft. and operators took side-wall cores in the Wilcox which indicated some shows. The well will be drilled to contract depth of 11,000 ft.

Gulf Refining Co. and associates have run a squeeze job in an attempt to eliminate formation water believed to be channeling behind casing in their 2 Ben J. Altheimer, et al, 24-4n-4e, prospective field opener in Avoyelles Parish. On 26-hour drill-stem test, it produced an estimated

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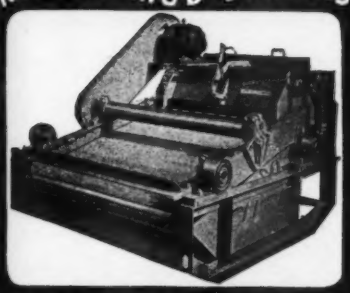

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50 bbl. of oil and 115 bbl. of salt water from the Wilcox at 4,422-44 ft. Shut-in pressure was 1,890 psi. The wildcat was drilled to total depth of 6,518 ft. and 5½-in. casing cemented at 4,508 ft. after running electric log. The well is located 1 mile south and ½ mile east of same operator's 1 Altheimer, 13-4n-43, which logged good showing in the Wilcox from 5,932-38 ft., but which failed to yield oil in commercial quantity.

J. B. Fletcher has started coring at 3,710 ft. in the upper Wilcox in 1 Wettermark, 78-6n-3w, wildcat at the Boyce townsite, Rapides Parish. The wildcat is due to test all sand series of the Wilcox.

Four and one-half miles west of the Morgan City townsite, St. Mary Parish, Sun Oil Co. and associates are at total depth of 13,596 ft. and are currently running 5-in. liner to 12,000 ft. in 1 Zenor, 42-15s-11e, The wildcat was originally scheduled to be drilled to 13,000 ft.

At its confirmation test to the new Kent Bayou field, Union Producing Co. is coring below 11,177 ft. in 2 Continental Land & Fur Co., 35-17s-13e, Terrebonne Parish. This test has been cored constantly since 11,110 ft. to 11,177 ft. with recovery being 100 per cent shale. Pay is to be sought to 11,500 ft., if necessary.

SOUTH LOUISIANA WILDCAT FAILURES

Calcasieu Parish: Niloco Co., et al, 1 Lutcher Moore Lumber Co. "B," 26-7s-11w, dry, TD 7,020 ft.

Jefferson Parish: Sohio Petroleum Co. 1 Mercier-McDonogh, 38-13s-22e, dry, TD 9,940 ft.

Mississippi

Tuscaloosa Cored in Adams County Venture

JACKSON.—In the Pine Ridge field area of Adams County, Mississippi, Dorris Ballew, Inc., 1 James Fowler, wildcat, 47-8n-2w, cored first Lower Tuscaloosa sand at 10,063 ft. Recovery from core 10,062-65 ft. was ashy sand with good oil odor, stain, taste, and fluorescence.

Operators attempted to drill-stem test from 10,065-68 ft., but the tool plugged imdiately after being opened. Mud and cuttings in the bottom of the tool had good oil odor and taste with no indication of salt water. Another core was cut from 10,068-70 ft. with recovery being 6 in. of fairly definite salt water sand. Another drill-stem test was attempted, but tool again plugged. When tool was pulled, about 500 ft. of the water cushion was gas cut and no evidence of salt water was found. At last report, operators were preparing to drill ahead.

In Baldwin County, Alabama, Gulf Refining Co. 1 B. D. Simison, et al, 43-1n-1e, located approximately 15 miles south and slightly west of South Carlton field, at last report was drilling at 7,460 ft. with no shows having been encountered. Operator found a chalk thickness of 1,866 ft. in the wildcat, which is thought to be abnormally thick for this area.

At R. J. Bartlett-Barnett Serio 1 George W. Armstrong, 37-6n-3w, discovery well for the New Era field, Adams County, operators have squeezed perforations in the Baker Shale and are preparing to reperforate the Parker zone at approximately 6,430 ft. Through perforations in the Baker at 6,325-27 ft., the well pumped an ungaged amount of fluid, being 25 per cent oil. Should the lower perforations in the Parker fail to produce, it is reported that operators will come back up the hole and perforate in the latest squeezed zone.

MISSISSIPPI WILDCAT FAILURES

Adams County: Hunter Jones 1 Joseph W. Parker, et al, 3-3n-5w, dry, TD 8,200 ft.

Lawrence County: Kerr-McGee Oil Industries, Inc., 1 Denkmann Lumber Co., 22-5n-11e, dry, TD 10,700 ft.

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Oklahoma

Roulette Creek Pool Discovery Confirmed

DISCOVERY last September of the Roulette Creek pool in eastern Cleveland County is being confirmed with a second producer, an east offset to the discovery well. It is Herman Brown 1 Roberts, SW SW NW 15-8n-1e, which also found excellent saturation in the Wilcox sand, the discovery well's producing horizon.

Top of the Wilcox sand was logged at approximately 6,418 ft. A drill-stem test at 6,452-63 ft. with the formation open 1½ hours yielded 1,110 ft. of clean oil and 90 ft. of oil-cut mud in the pipe breakdown. A substantial gas flow was made during the last 75 minutes of the test. Hole was deepened to 6,473 ft., where a second test was made, taking in the interval below 6,463 ft. Tester was open 140 minutes. Gas flowed within 26 minutes, fluid was at the top within 1 hour and 45 minutes, and during the last 20 minutes oil flowed at an estimated rate of 20 bbl. per day.

The recently revived West Prague pool in Lincoln County is developing into an important producing area. The third good producer in the revived development has been completed by California Exploration Co. at its 1 Reel-Way, SE SE NW 19-12n-6e, northwest diagonal offset to the initial well in the new development. The well, with casing perforated at 4,451-60 ft. in the pool's Misener-Hunton pay zone, flowed at the rate of 375 bbl. of 40° oil per day on a 4-hour run. Hole had been drilled to a total depth of 4,727 ft. in Wilcox sand, in which casing was run to 4,700 ft. Wilcox showed water.

The initial well of the new development was completed early this month by Ned Biffle at his 1 Way, NW NW SE 19-12n-6e, which flowed 525 bbl. per day from the Hunton zone at 4,432-38 ft. Biffle has just completed 2 Way, a west offset, and to which the California Exploration well is a north offset. The area is about ½ mile north of the original and only other producer which had been abandoned after a short life.

Production at the west end of the Elk City field in Beckham County is being extended another location west and south at Shell Oil Co. 1 Miller, 18-10n-21w, which flowed 494 bbl. of 52.4° oil in 11 hours through 5/8-in. choke. Gas was gaged at the rate of 1,074,000 cu. ft. per day. Production is from casing perforations at 9,810-25 ft. and 8,550-55 ft. Total depth is 10,105 ft., with hole plugged back to 10,050 ft.

Schermerhorn Oil Corp. 1 Bridall, NE NE SE 5-19n-2w, an exploratory test in the recently opened North Marshall pool area, is preparing to test promising oil and gas showings found in both the Prue and Layton sands. A 30-minute drill-stem test at 4,755-75 ft. in the Layton sand showed gas within 13 minutes and yielded some free oil with 150 ft. of oil-cut mud. A 30-minute test at 5,254-85 ft. in Prue sand flowed gas within 6 minutes at an estimated rate of 3,500,000 cu. ft. per day. With the gas was a spray of distillate, and in the breakdown 6 ft. of the latter products was recovered.

Kenneth Nix 1 Norris, C SW SW 17-4n-5e, ¾ mile northeast of the Center pool, Pontotoc County, is being put on the pump as a small producer to establish either a new pool or an extension to the former pool. Total depth is 1,281 ft. with 5½-in. casing at 1,162 ft. Possible productive sands were logged at 1,261-81 ft., 1,080-84 ft., and 983-88 ft.

OKLAHOMA SUCCESSFUL WILDCATS

Carter County: Gibson 1 Sullivan, NW NE SE 5-5s-1w, flowed 152 bbl. oil from Arbuckle at 4,822-79 ft., TD 5,199 ft., Lone Grove 3,653 ft., Simpson 4,446 ft., OWDD.

Lincoln County: Biffle 1 Way, NW NW SE 19-12n-6e, elev. 1,004 ft., flowed 520 bbl. oil from Hunton at 4,430-70 ft., TD 4,707 ft., Earlsboro 3,670 ft., Inola 3,807 ft., lime 3,945 ft., Mississippian Caney 4,050 ft., Mayes 4,255 ft., Woodford 4,390 ft., Misener 4,420 ft., Hunton 4,423 ft., Chimney Hill 4,440 ft.

Major County: Kaye et al 1 Berry est., NE NE NW 7-21n-10w, elev. 1,256 ft., flowed 108 bbl. oil from upper Manning at 6,832-6,876 ft., TD 7,276 ft., Oswego 6,369 ft., Mississippi lime 7,223 ft.

Okfuskee County: Mohawk Drilling et al 1 Foster, NE SW SE 6-13n-9e, elev. 753 ft., pumped 14 bbl. oil from Dutcher at 3,257-3,303 ft., TD 3,337 ft., Hogshooter 579 ft., Checkerboard 1,030 ft., Wewoka 1,397 ft., Prue 2,101 ft., Verdigris 2,199 ft., Senora 2,282 ft., Inola 2,747 ft., Bartlesville 2,827 ft., Booch 3,064 ft.

Texas County: American Gas 1 Stonebraker, NW NW SE 21-3n-12ecm., flowed 10,200,000 cu. ft. of gas per day from Krider at 2,648-2,700 ft., TD 2,765 ft.

OKLAHOMA WILDCAT FAILURES

Cleveland County: Harper-Turner and Pan-American 1 Vinez, C SE SE 8-8n-1w, elev. 1,193 ft., dry, TD 7,835 ft., Hogshooter 5,143 ft., Checkerboard 5,556 ft., Deese 5,760 ft., Oswego 6,300 ft., Prue 6,450 ft., Bartlesville 6,605 ft., Woodford 6,725 ft., Hunton 6,785 ft., Chimney Hill 7,083 ft., Sylvan 7,152 ft., Viola 7,263 ft., first bromide 7,593 ft., second bromide 7,775 ft.

Creek County: Jackson 1 Freda, SW SE SW 13-14n-7e, elev. 866 ft., dry, TD 4,097 ft., Hogshooter 1,254 ft., Layton 1,390 ft., Checkerboard 1,665 ft., Oswego 2,574 ft., Verdigris 2,681 ft., Skinner 2,774 ft., Bartlesville 3,172 ft., Dutcher 3,480 ft., Mississippian Caney 3,517 ft., Mayes 3,657 ft., Woodford 3,883 ft., Sylvan 3,914 ft., Viola 4,000 ft., Wilcox 4,048 ft., second Wilcox 4,068 ft.

Lincoln County: Falcon Seaboard 1 Krieg, NW NW SE 28-14n-2e, elev. 874 ft., dry, TD 4,899 ft., Hogshooter 3,570 ft., Checkerboard 3,785 ft., Oswego 4,455 ft., Prue 4,505 ft., Verdigris 4,575 ft., Red Fork 4,705 ft., Inola 4,770 ft., Bartlesville 4,860 ft.

Berkey 1 Noble, NW NW NW 19-15n-5e, elev. 828 ft., dry, TD 4,031 ft., Hogshooter 2,490 ft., Checkerboard 2,800 ft., Oswego 3,455 ft., Prue 3,506 ft., Red Fork 3,769 ft.

Logan County: Harper-Turner et al., 1 Sharum SE SE SE 7-15n-1w, dry, TD 6,190 ft., Big lime 5,262 ft., Oswego 5,313 ft., Verdigris 5,429 ft., Woodford 5,575 ft., Hunton 5,697 ft., Sylvan 5,745 ft., Viola 5,872 ft., Wilcox 6,004 ft., second Wilcox 6,108 ft.

Love County: Carlock & Vickers 1 Evans, SW SW SW 11-7s-3w, elev. 745 ft., dry, TD 7,330 ft., Cisco-Hoxbar 2,735 ft., middle Hoxbar 4,555 ft., Confederate 5,395 ft., Deese 6,473 ft., Deese lime 6,945 ft.

Muskogee County: Parks 1 Stamp and Cornelius, SE NW SE 2-13n-15e, dry, TD 2,212 ft., Booch 1,410 ft., lime 2,037 ft., Dutcher 2,207 ft.

Noble County: Fleet Drilling et al., 1 Wagner, NW NW SE 25-21n-2w, elev. 1,165 ft., dry, TD 5,512 ft., Perry 3,670 ft., Layton 3,958 ft., Checkerboard 4,117 ft., Big lime 4,422 ft., Oswego 4,548 ft., Mississippi lime 5,022 ft., Woodford 5,230 ft., Misener 5,285 ft., Viola 5,300 ft., Wilcox 5,378 ft., second Wilcox 5,465 ft.

Okmulgee County: Geological test in Okmulgee pool—Pine 1 Clue, SW SE SE 2-13n-12e, elev. 641 ft., dry, TD 3,256 ft.,

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Osage County: Oliphant 1 Osage, NW NW SW 3-24n-10e, dry, TD 2,160 ft., Big lime 1,440 ft., Oswego 1,653 ft., Bartlesville 2,093 ft., Mississippi lime 2,152 ft.

Pawnee County: Davidor & Davidor 1 Garrett est., SW SE SW 20-22n-6e, elev. 915 ft., dry, TD 3,293 ft., Hogshooter 2,040 ft., Layton 2,070 ft., Oswego 2,560 ft., Prue 2,731 ft., Skinner 2,825 ft., Mississippi lime 3,045 ft., Woodford 3,235 ft., Wilcox 3,258 ft.

Payne County: Parker 1 Kelley, NE NE NW 17-18n-5e, dry, TD 2,918 ft., Layton 2,320 ft., Checkerboard 2,597 ft., Peru 2,847 ft.

Pontotoc County: Sanders Oil 1 Grace, NE NE SW 10-3n-5e, dry, TD 3,124 ft., Cromwell 1,621 ft., Mississippian Caney 2,290 ft., Woodford 2,540 ft., Hunton 2,888 ft., Sylvan 2,948 ft.

Seminole County: Keener Oil & Gas 1 Swan, SW NE NW 33-6n-6e, elev. 925 ft., dry, TD 1,708 ft., base Wewoka 1,402 ft., upper Calvin 1,548 ft., lower Calvin 1,653 ft., sand 1,663 ft.

Washita County: Stanolind Oil & Gas and California Co. 1 Slatten, C NW NW 13-9n-18w, elev. 1,721 ft., dry, TD 11,300 ft., granite wash 3,826 ft., Hoxbar 7,320 ft., Kansas City 8,065 ft., shale and conglomerate 9,339 ft., conglomerate 9,690 ft., granite wash 10,292 ft. and 10,340 ft., conglomerate 10,362 ft. and 10,390 ft.

California

New Hancock Gets Another Disappointment

LOS ANGELES.—The Hancock area, northwestern Cuyama's most recent oil discovery, has been given a further setback. In August, Hancock Oil Co. 4 Bishop was completed in the center of 31-32s-20e, for a 250-bbl. pumper at 5,886-6,015 ft. An attempted step-out ½ mile to the northwest was a failure. The second, a southeast offset, last week failed to make a producer in the deep pay and likewise was unsuccessful in the Dibblee zone at about 2,020 ft.

In the Los Angeles Basin area, General Petroleum Corp. has drilled below 11,500 ft. at its wildcat in the La Mirada area. Last reports showed the well, located in 22-3s-11w, to be coring at 11,548 ft. At its deep test in the Huron area of Fresno County, San Joaquin region, the company suspended drilling at 14,724 ft. This wildcat, its 44-14 B.L.C., is in 14-20-18e.

CALIFORNIA SUCCESSFUL WILDCATS

Kern County: Richfield Oil Corp. 1 Shields-Arms, 32-29s-29e, flowed 354 bbl. 12.5°-gravity oil, Olcese oil sand (Miocene) 3,490 ft., TD 3,672 ft.

Los Angeles County: Texas Co. 2 Honor Rancho (NCT-1), 1-4n-17w, flowed 260 bbl. 34°-gravity oil, 6,408-6,527 ft., TD 6,642 ft.

Humble Oil & Refining Co. 3 Newhall Land & Farming Co., 24-4n-17w, flowed 264 bbl. 22.2°-gravity oil, upper Mohnian sand, 9,815-65 ft., TD 10,115 ft.

CALIFORNIA WILDCAT FAILURES

Alameda County: Hancock Oil and Signal 1 R. A. Hansen, 21-3s-2e, dry, TD 7,325 ft.

Contra Costa County: Standard Oil Co. of Calif. 1 Canada Comm., 34-2n-2e, dry, TD 2,835 ft.

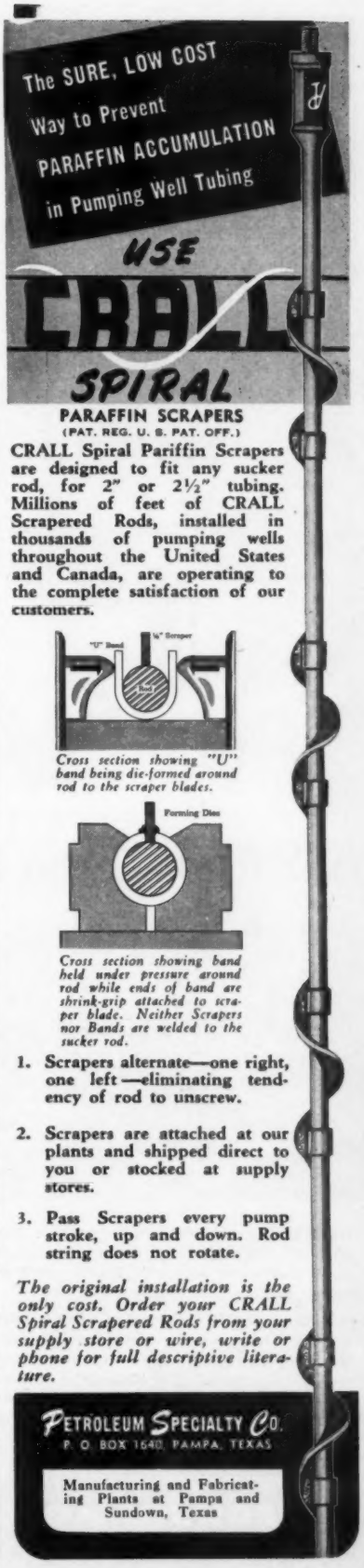
Kern County: Steele Petroleum Co. 41-23 KCL-WSP, 23-10n-22w, dry, granite 760 ft., TD 850 ft.

Tejon Hills Oil Co. 29 Tejon Hills, 11-11n-18w, dry, TD 872 ft.

Los Angeles County: Coast Exploration Co. 1 Dotta, 19-2n-16w, dry, Miocene 1,780 ft., TD 2,983 ft.

San Luis Obispo County: D & D Oil Co. 1, 6-11n-26w, dry, TD 1,925 ft.

Ventura County: Ojai Oil Co. 9 Ojai, 12-4n-22w, dry, TD 469 ft.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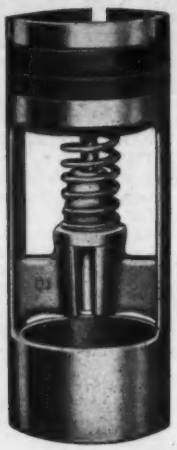

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Kansas

Clark County Wildcat Finds Viola Showings

VIOLA lime has been added to the prospective productive zones encountered by Stanolind Oil & Gas Co. in its 1 Wall, C NE SE 35-32-23, rank wildcat test in Clark County, in the Hugoton embayment, in the southwestern part of the state. Showings in the Viola in this test are the first of any consequence ever found below the Mississippian in any test ever drilled in the general section of the state.

Top of the formation was logged at 6,421 ft. (—4,393 ft.). First drill-stem test in this zone was made of an interval at 6,527-33 ft. It resulted in a good gas flow and a final recovery in the pipe breakdown of 70 ft. of gassy oil and 65 ft. of clean 42.6° oil. Bottom-hole pressure was 2,300 psi. Tester was open 60 minutes. Gas was at the surface within 32 minutes.

Hole then was cored ahead to 6,588 ft., where a second test was made, taking in the interval below 6,565 ft. With tester open 60 minutes, gas was at the top within 48 ft. The breakdown yielded 35 ft. of 43° gravity oil and 75 ft. of heavily oil and gas-cut mud. Bottom-hole pressure was 2,100 psi.

Previously promising oil and gas showings had been encountered in the Lansing-Kansas City section. Gas showings of lesser importance were found in the Mississippian. Hole is being cored and drilled ahead.

Pickerell Drilling Co. has indications of an unusual well in its 1 Duggan, NE SW SW 30-21-11, ¾ mile south of nearest production in the Sand Hills pool, Stafford County. With casing perforated at 3,489-95 ft. and 3,479-85 ft. in the conglomerate zone, the hole filled 3,400 ft. with oil. the fill-up is from the upper perforations. The lower perforations, made first, indicated no showing. Top of the conglomerate was logged at 3,468 ft. (—1,683 ft.). Prior to testing this zone, hole had been drilled to the Arbuckle, topped at 3,545 ft. Casing was run 3 ft. in and hole deepened to 3,584 ft. but no showings were found in that zone.

Continuing swabbing tests after a 500-gal. acid treatment, Imperial Petroleum Co. 1 Vogel, SE SE NE 14-3-19, which is opening a new pool in the area 1½ miles south of the Dayton pool, in Phillips County, at the upper end of the Central Kansas Uplift, produced at the rate of 15 bbl. of oil per hour. Swab was run 1,000 ft. off bottom. Total depth is 3,150 ft. in Lansing lime topped at 3,128 ft. (—1,115 ft.). Hole is open below 3,146 ft.

KANSAS SUCCESSFUL WILDCATS

Lyon County: Sauder et al., 1 Davey, SE NW SW 31-21s-12e, pumped 9 bbl. oil from Bartlesville at 1,776-93 ft., TD 1,839 ft.

Nemaha County: Carter 1 Strahm, NW SW NW 13-2s-14e, elev. 1,240 ft., pumped 388 bbl. oil from Hunton at 2,826-34 ft., 2,842-55 ft., and 2,855-56 ft., TD 3,929 ft., Lansing-Kansas City 1,264 ft., Mississippi lime 2,415 ft., Viola 3,480 ft., Simpson shale 3,722 ft., Simpson sand 3,737 ft., granite 3,929 ft.

Russell County: Mid-Plains 3 Chedwiggen "B," CSL SE SW 28-15s-11w, elev. 1,837 ft., pumped 60 bbl. oil from Lansing-Kansas City at 3,020-24 ft., 3,163-65 ft., and 3,168-74 ft., TD 3,315 ft., Sooy 3,284 ft., quartz 3,312 ft.

Stafford County: Murfin et al., 1 Pelter, NW NW SE 26-21s-14w, elev. 1,928 ft., pumped 230 bbl. oil from Lansing-Kansas City at 3,569-73 ft. and 3,591-95 ft., TD 3,797 ft., Heebner 3,282 ft., Viola 3,684 ft., Simpson 3,733 ft., Arbuckle 3,777 ft.

Trego County: Peel-Hardman 1 Walz, SE SE SW 12-11s-21w, elev. 2,091 ft., pumped 397 bbl. oil from Arbuckle at 3,666-80 ft., TD; Heebner 3,334 ft., Toronto 3,350 ft., Lansing-Kansas City 3,371 ft.

KANSAS WILDCAT FAILURES

Barton County: Todd Drilling et al., 1 Grizzell, SE SE SE 2-18s-11w, elev. 1,791 ft., dry, TD 3,396 ft., Lansing-Kansas City 3,031 ft., Arbuckle 3,346 ft. Westgate-Greenland 1 Krentzel, NW NW NW 12-19s-13w, dry, TD 3,453 ft., Lansing-Kansas City 3,138 ft., Arbuckle 3,418 ft.

Butler County: Rex & Morris 1 Kaufman, SE SE SE 12-23s-4e, elev. 1,435 ft., dry, TD 2,452 ft., chat 2,442 ft.

Coffey County: Neustadt 1-A Bahr, NE SE SE 33-22s-14e, dry, TD 1,370 ft., Peru 1,330 ft.

Cowley County: Gralapp-McNish 1 Brodbeck, NW SW SE 6-30s-4e, elev. 1,166 ft., dry, TD 3,135 ft., Kansas City 2,246 ft., Mississippi lime 2,968 ft., Arbuckle 3,119 ft.

Carter 1 Taylor, SE NE NE 12-33s-6e, dry, TD 2,895 ft., Lansing-Kansas City 1,541 ft., Oswego 2,395 ft., Bartlesville 2,738 ft., Mississippi lime 2,848 ft.

Ellis County: Barnett-NCRA 1 Scheck, SW SW SW 18-12s-16w, elev. 2,144 ft., dry, TD 3,770 ft., Lansing-Kansas City 3,388 ft., Arbuckle 3,738 ft.

Jackson & Lindsay 1 Riedel, NE NE SW 11-13s-16w, elev. 1,952 ft., dry, TD 3,466 ft., Lansing-Kansas City 3,172 ft., Arbuckle 3,436 ft.

Ellsworth County: Keystone 1 Freshe, SW SW SW 30-16s-8w, dry, TD 3,340 ft., Lansing-Kansas City 2,833 ft., Viola 3,237 ft., Simpson 3,285 ft., Arbuckle 3,321 ft.

Graham County: Nadel & Gussman 1 Dixon, SW NW SW 12-8s-22w, elev. 2,046 ft., dry, TD 3,653 ft., Lansing-Kansas City 3,276 ft., Arbuckle 3,628 ft.

Greenwood County: Ashlock 1 Boone, SE SE SE 2-26s-12e, dry, TD 1,715 ft., Bartlesville 1,500 ft., Mississippi lime 1,610 ft.

Kingman County: Pabco 1 Cavit, SW SE SW 32-27s-5w, elev. 1,431 ft., dry, TD 3,830 ft., Lansing-Kansas City 2,974 ft.

Westgate-Greenland 1 Hennings, SE SE NW 10-28s-6w, elev. 1,509 ft., dry, TD 3,973 ft., Lansing-Kansas City 3,086 ft., Mississippi lime 3,873 ft.

Morris County: Atkinson Bros. et al., 1 King, NE SW SW 30-16s-6e, dry, TD 2,434 ft., Mississippi chat 2,165 ft., Hunton 2,427 ft.

Phillips County: Stableford and K & E 1 Coswell, NE NE NW 2-1s-18w, elev. 2,052 ft., dry, TD 3,505 ft., Lansing-Kansas City 3,331 ft.

Pratt County: Harbar et al., 1 Thompson, SW SW NE 27-28s-13w, elev. 1,934 ft., dry, TD 4,619 ft., Lansing-Kansas City 3,858 ft., Mississippi lime 4,301 ft., Viola 4,348 ft., Simpson 4,413 ft.

Rush County: Coppinger 1 Delkers, NE NW SW 4-16s-19w, elev. 2,053 ft., dry, TD 3,685 ft., Lansing-Kansas City 3,385 ft., Regan 3,671 ft.

Stafford County: Westgate-Greenland 1 Williams, NW NE NW 16-21s-12w, elev. 1,844 ft., dry, TD 3,534 ft., Lansing-Kansas City 3,229 ft., Arbuckle 3,496 ft.

Musgrove 1 Dunne, SW SW NW 26-23s-13w, elev. 1,891 ft., dry, TD 3,991 ft., Lansing-Kansas City 3,495 ft., Viola 3,820 ft., Simpson 3,879 ft., Arbuckle 3,936 ft.

Sumner County: Pyramid 1 Sellers, SW SW NW 5-33s-5w, elev. 1,225 ft., dry, TD 4,412 ft., Kansas City 3,310 ft., Mississippi lime 3,985 ft., Simpson 4,405 ft.

Michigan

Gladwin County Has Dundee Oil Prospect

MOUNT PLEASANT.—Don Rayburn had a potential discovery in Sherman Township, Gladwin County, this week at his 1 Cassidy et al., S½ SW SE 30-20n-2w. The wildcat flowed oil from the Dundee in 27 minutes on drill-stem test from 3,847

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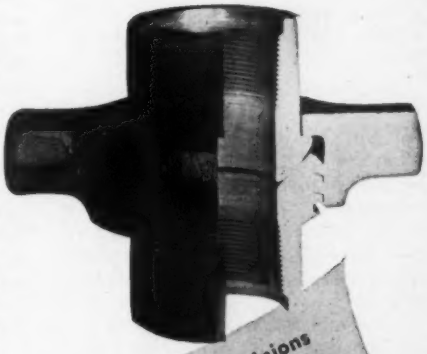

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ft., total depth. Gas started to show in 5 minutes. After oil was flowed to pits for about 2 minutes, circulation was reversed and hole was conditioned for 5-in. casing which was cemented at 3,828 ft.

The prospect is located in a fairly wide open area about 12 miles northwest of Buckeye Dundee oil pool, and 1 mile east and south of Freeman Oil Co.'s previous "sour" zone (Detroit River) oil producer in SE SE 25-20n3w.

MICHIGAN WILDCAT FAILURES

Allegan County: N. R. Dodd and Midwest Drilling Co. 1 Currie, NE NE SW 2-1n-14w, Traverse 1,331 ft., dry, TD 1,361 ft.

Isabella County: Union Development Co. 1 Rank, SE SE SW 13-16n-3w, Dundee 3,744 ft., dry, TD 3,796 ft.

Union Development Co. 1 Burton, SE SE NE 14-16n-3w, Dundee 3,740 ft., dry, TD 3,860 ft.

Newaygo County: M. B. Belden 4 Belden & Fawcett, NW NW NE 33-16n-14w, Traverse 2,152 ft., dry, TD 2,163 ft.

Osceola County: Sun Oil Co. 7 Richardson et al., SE NW SW 11-18n-9w, dry in Stray-Marshall, TD 1,642 ft.

Van Buren County: W. D. Gannett 1 Burns & Tavso Comm. SE SE SW 26-2s-13w, Traverse 1,299 ft., dry, TD 1,331 ft.

Appalachian Field

Bad Weather Hampering Appalachian Operations

PITTSBURGH.—Bad weather continues to hamper operations in the Appalachian fields.

In Napier Township, Bedford County, Pennsylvania, South Penn Oil Co. et al (Snee & Eberly) 1 Jessie B. Miller, elevation 1,666 ft., is drilling at a depth of 8,464 ft.

In Tolcott district, Summers County, West Virginia, Godfrey L. Cabot, Inc., 1330 S. H. Pence, elevation 1,798 ft., is drilling at 2,890 ft. In the Steele district, Wood County, Davis-Kelly Oil & Gas Co. 1 Charles D. & Audrey Post, elevation 848 ft., is drilling at 2,600 ft.; United Fuel Gas Co. 651 Ralph Ayers, elevation 951 ft., is drilling at 2,233 ft.

Louisiana-Arkansas

Union County Activity Revived by Apparent Hit

SHREVEPORT.—Roberts Petroleum Co. 1 Lena may open a new Travis Peak area in Union County. The well swabbed oil at an indicated rate of 100 bbl. per day from the upper part of the formation at 2,924-40 ft. The nearest production is in Rainbow City field 3 miles to the south. The test is located in 26-17s-14w, 4 miles east of Nick Springs and 13 miles east of El Dorado fields.

Near Lewisville, Lafayette County, A. M. Shirey, Jr., et al., 1 Sheffield cored silty sand with oil stains at 4,009-12 ft. Earlier shows had been found at 2,989-94 ft. Located in 12-16s-24w, the test is drilling below 4,200 ft. toward its objective around 4,600 ft.

In Tensas Parish, Louisiana, D. M. Lide got his second discovery this year at his 1 Mrs. Jacoby et al., 1-12n-12e. The strike flowed 529 bbl. of 54.5-°gravity distillate and 750,000 cu. ft. of gas from 8,808-18 ft. The well is southeast of Newellton, which is the tentative name of the new pool.

NORTH LOUISIANA WILDCAT FAILURES

Caddo Parish: Burnham & Browning 1-A

McCain, 12-19n-16w, dry, TD 3,506 ft., Blossom 1,861 ft.
Caldwell Parish: J. S. Michael F-2 Nebo, 27-13n-5e, dry, TD 2,832 ft.
Concordia Parish: Becknett & Ballew 1 Keenan, 13-7n-6e, dry, TD 6,392 ft.

Illinois-Ind.-Ky.

Another Pool Indicated In Spottsville District

DISCOVERY of another new pool in the Zion-Spottsville area in northeastern Henderson County, western Kentucky, appears to have been made by National Associated Petroleum Co. at its 1 Christiansen, NW SW SW 20-Q-25, which got a good flow of clean oil in a drill-stem test in McClosky lime. The well was drilled "tight" and detailed information has not been released by the operators, but the zone tested is reported to have been at 2,225-30 ft. Oil was at the surface within 30 minutes after the tester was opened.

Location is about a mile west of the town of Spottsville and about ¾ mile northeast of production in the Spottsville pool. The active and prolific Zion North pool, opened earlier this year, is about 2 miles to the southwest.

Testing is under way at Vic Gallagher 1 Taran, SE SE SE 16-6s-14w, a wildcat in the Grafton area, about 5 miles northeast of Mt. Vernon, southern Posey County, Indiana. Prospective pay zone is the Waltersburg sand at 2,122-33 ft. In a drill-stem test of the zone, the well got a substantial showing of gas and flowed clean oil. Tester was open 60 minutes with gas at the surface within 47 minutes and oil within 54 minutes.

The second well is being completed and a new pay zone proved for production in the new shallow pool opened by E. Michel in the area 4 miles south of Elnora, in Daviess County, Indiana. It is 2 Caswell Woodruff, NE NW SW 34-5n-6w, about ¼ mile northeast of 1 Woodruff, the discovery well, completed late in November. Placed on the pump, it produced 120 bbl. of oil in the first 23 hours. Pay zone is McClosky lime at 763-65 ft. The discovery well, pumping about 8 bbl. net oil, is producing from Salem lime at 1,096-1,101 ft. McClosky lime failed to show in that well. The area is 4 to 5 miles east of the Plainville pool, nearest production. Main oil zones at Plainville are the McClosky and Aux Vases, found at approximately the same depth as in the new Elnora area. Salem lime at Plainville yields gas.

Howard D. Atha 1 Hoskins NE NW SE 36-6s-8e, ½ mile north of the Roland pool, White County, Illinois, is being put on the pump following swabbing tests in which it produced 580 bbl. of oil in 40 hours. Production is from the O'Hara and Rosiclare, both new pay zones for the Roland pool. The former zone produces through casing perforations at 2,960-66 ft. and the Rosiclare at 2,978-85 ft.

Skiles Oil Corp. has completed its 1 Osborne, 6-N-23, a wildcat in the Poole area, Webster County, western Kentucky. The well pumped 127 bbl. net oil per day from Tar Springs sand at 1,927-49 ft. It is about a mile west of the town of Poole and about the same distance from other production. Confirmation of the discovery is being given by the company's 2 Osborne, same section, which swabbed at the rate of 3 bbl. of oil per hour while testing the same pay zone at 1,910-28 ft. Pumping equipment is being installed.

ILLINOIS SUCCESSFUL WILDCAT

Clinton County: Gaiza & Schierman 1 Peters, SW NE SE 22-2n-3w, IP 16,000 cu. ft. gas, Cypress 1,102-06 ft., TD 1,114 ft.

ILLINOIS WILDCAT FAILURES

Clark County: K. R. Sutton 1 Bradford, NE NE NW 23-12n-14w, dry, TD 364 ft.
Coles County: F. B. Blunk 1 Slater, NW SW SE 21-14n-14w, dry, TD 154 ft.
Effingham County: The Texas Co. 1 Town, NW NW SW 3-6n-5e, dry, TD 2,552 ft.
Fayette County: Continental Oil Co. 1 Springman, NW SE NW 26-8n-2e, dry, TD 2,039 ft.
A. V. Johnson 1 Schroder, SE SE NW 20-5n-3e, dry, TD 2,205 ft.
Macon County: D. M. Perkins 1 Keller, SE SE NE 30-15n-2e, dry, TD 2,433 ft.
Richland County: George & Wrather 1 Street, NE NE NW 20-4n-10e, dry, TD 3,085 ft.
Sanders & Frye 1 Stover, SW SW NW 34-5n-10e, dry, TD 2,990 ft.
White County: Ashland Oil & Refining Co. et al., 1 Tate, SW SW SE 35-5s-9e, dry, TD 3,253 ft.

INDIANA SUCCESSFUL WILDCAT

Knox County: Graham Development Co. 3 Myers, SE NW SW SW 1-2n-9w, IP 45 bbl., Rosiclare 1,566-68 ft., TD 1,568 ft. (opens new pay zone Monroe City North pool).

INDIANA WILDCAT FAILURE

Vanderburgh County: F. B. Drilling Co. 1 Reece, NW NW SW 8-6s-11w, dry, TD 2,720 ft.

WESTERN KENTUCKY SUCCESSFUL WILDCATS

Ohio County: Earl 1 Briney 1 Roby, NE NE SW 16-O-33, IP 30 bbl., Cypress 805-20 ft., TD 820 ft.
Webster County: Skiles Oil Corp. 1 Luke Osborne, 6-N-23, IP 127 bbl., Tar Springs 1,927-49 ft., TD 1,949 ft.

WESTERN KENTUCKY WILDCAT FAILURES

Daviess County: W. K. Snyder 1 Christian, NE NW SW 16-O-31, dry, TD 1,050 ft.
Hancock County: National Associated Petro-

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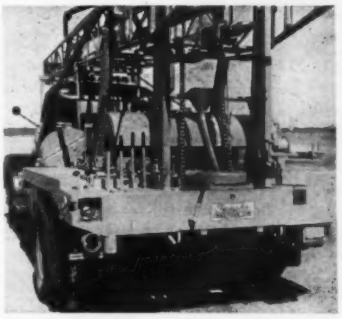

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Drive attachment can be furnished for drilling 3" or 4" casing, important where boulders are encountered. Chain transmission drive unit encloses all chains, sprockets and clutches in an oil bath. 2" opening through water swivel and piping reduces pump pressures and expedites removal of cuttings from hole. To 1500 feet FRANKS KC-45H is tops!

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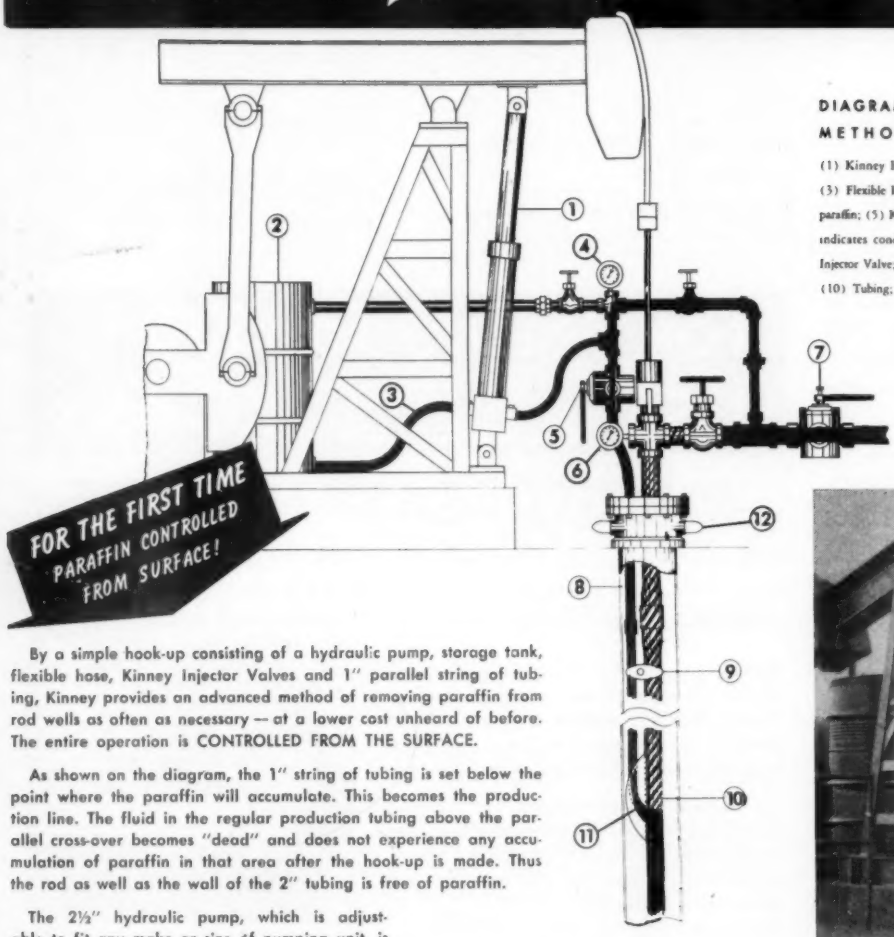


DIAGRAM OF HOOK-UP AND METHOD OF OPERATION

(1) Kinney Hydraulic Pump; (2) Supply Tank; (3) Flexible Hose; (4) Gauge, indicates removal of paraffin; (5) Kinney Plug Injector Valve; (6) Gauge, indicates condition of paraffin; (7) Kinney Plug Injector Valve; (8) 1" Tubing; (9) Parallel Clamp; (10) Tubing; (11) Crossover; (12) Parallel Head.

- **Production Fluid**
- **Dead Fluid**

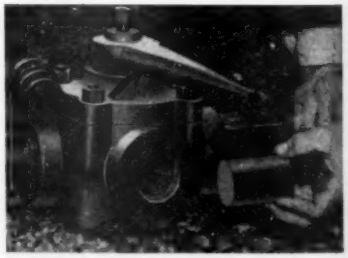
FOR THE FIRST TIME PARAFFIN CONTROLLED FROM SURFACE!

By a simple hook-up consisting of a hydraulic pump, storage tank, flexible hose, Kinney Injector Valves and 1" parallel string of tubing, Kinney provides an advanced method of removing paraffin from rod wells as often as necessary — at a lower cost unheard of before. The entire operation is CONTROLLED FROM THE SURFACE.

As shown on the diagram, the 1" string of tubing is set below the point where the paraffin will accumulate. This becomes the production line. The fluid in the regular production tubing above the parallel cross-over becomes "dead" and does not experience any accumulation of paraffin in that area after the hook-up is made. Thus the rod as well as the wall of the 2" tubing is free of paraffin.

The 2½" hydraulic pump, which is adjustable to fit any make or size of pumping unit, is designed to operate only when injecting the plugs in the well. The connecting head of the hydraulic pump is easily engaged or disengaged by merely slipping or pulling it from a slot. When the pumping pressure builds up due to paraffin accumulation in the 1" production line it is reflected on Gauge, Figure 6. A Kinney Soluble-Mechanical Plug is injected in Valve, Figure 5; the Hydraulic Pump is connected to pumping unit, and the plug is forced down the tubing below the paraffin line but safely above the opening of the main tubing. When the hydraulic pump is cut-off, the pressure is then reversed and the plug carried up through the tubing and out into the flow line. This procedure is done as often as is necessary to remove paraffin without any shut-down of the well except when necessary to connect and disconnect the hydraulic pump. The entire system is complete and available for easy installation. Instructions for installing are furnished. Once installed all that is necessary to keep the tubing and flow lines free of paraffin is to insert the soluble-mechanical plugs at intervals. By reducing the load on pumping equipment caused by paraffin deposits, the Kinney Paraffin System cuts initial equipment costs, and cuts paraffin elimination costs as much as ONE-HALF each month.

A Kinney Hydraulic Paraffin System on major oil company well in West Texas.



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leum Co. 1 Duncan, SW NE SW 16-Q-30, dry, TD 930 ft.

Henderson County: Frank Murta 1 Cates, SW SE SE 2-O-23, dry, TD 2,607 ft.

L. P. Galambos 1 Orenshaw, 23-Q-21, dry, TD 2,680 ft.

EASTERN KENTUCKY

ASHLAND.—In Breathitt County and on Boone Fork, Jack Kindred is spudding on 1 Edna Hurst in the northwestern section of the county. New test is in the general area of old Wilhurst oil and gas field.

Also in Breathitt County, Glen McCoun is drilling below 325 ft. on 1 Marcus Carpenter located on Quicksand Creek. It will likely test possible pays in the Corniferous.

In Big Sandy gas field, Pike County sector, W. W. Lindsey completed 1-975 Kentucky West Virginia Gas Co. W. J. Ray for 1,050,000 cu. ft. of gas daily from Maxon (Mississippian) sand at total depth of 1,476 ft.

EASTERN KENTUCKY WILDCAT FAILURE

Morgan County: Jim Patton 1 R. O. Prater, State Road Fork, dry, TD 1,911 ft., in Corniferous lime.

Rocky Mountain

Bonanza Area Wildcat Flows Oil on Test

DENVER.—Bonanza Oil Co. of Denver found oil at a shallow depth at a wildcat in the Bonanza area on the east side of the Big Horn basin, Wyoming. The 1 Government, C SW NE 26-49n-91w, Big Horn County, topped the Tensleep at 2,483 ft. On drill-stem test 2,480-2,528 ft., tool open 1½ hours, it flowed at the rate of 48 bbl. of oil per hour through ½-in. choke. The oil is 34°-gravity, asphalt base. The operator is now running casing with the well at 2,528 ft., total depth.

Failure of a deep wildcat on the east side of the Powder River basin was a disappointment for future drilling away from the basin rim in this area. A. B. Cobb of Great Falls, Mont., and Superior Oil Co. plugged 1 Unit, C SE SE 5-40n-68w, Dull Center area, Converse County, at 9,667 ft., total depth in the Morrison. No shows were reported for Dakota or Lakota sands, the primary objectives. This well was located following extensive seismic work through this area of the basin. There had been no previous deep drilling in this part of the basin, northwest of Lance Creek fields and southwest of Mush Creek-Fidler Creek area.

Colorado.—Mountain Fuel Supply Co. is near its Dakota objective at the deep test in Hiawatha gas field, Moffat County. The 1 Unit, Lot 5, Section 14-12n-100w, is now the deepest well ever drilled in the state. Drilling is below 14,025 ft., with Delta Drilling Co. of Tyler, Tex., handling the contract. This field has produced gas from shallow Tertiary sands, but there has been no previous deep drilling in the field. If the well is successful in deeper zones, it is probable there will be considerable wildcat drilling through the general area of the Green River basin.

C. S. Atchison, of Houston, Tex., spudded a wildcat on a farmout from Shell in the Cottonwood area, Weld County, at 1 Reagan, NE NE SE 11-10n-56w. M. J. Florance of Aztec made location for 1 Florance-Newton, SW SE NE 5-33n-2w, southwest of Pagosa, Archuleta County. Hathaway Brothers of Santa Fe Springs, Calif., staked 1 Lyon-Federal, C SW SE 11-37n-20w, Montezuma County.

WYOMING WILDCAT FAILURES

Crook County: Montah-Wyco Oil Corp. 1 Govt., NW NW NW 15-57n-65w, TD 2,700, dry, Madison 2,550 ft.

Natrona County: West Alcova Oil Co. 2 Govt., NW SW NE 15-30n-84w, TD 2,300 ft., dry, Casper 890 ft., Madison 1,250 ft., Deadwood 1,330 ft., pre-Cambrian 1,640 ft.

Niobrara County: Continental Oil Co. 1 Holbrook, SW SW NW 12-35n-64w, TD 4,751 ft., dry, Niobrara 2,315 ft., Greenhorn 3,020 ft., Graneros 3,138 ft., Muddy 3,782 ft., Dakota 3,975 ft., Lakota 4,172 ft., Morrison 4,217 ft., Sundance 4,518 ft.

Weston County: H. O. Beadle, O. A. Roberts and Woodward Oil Co. 1 Govt., SE SE SE 24-45n-64w, TD 4,270 ft., dry, Newcastle 4,190 ft.

COLORADO WILDCAT FAILURE

Logan County: Ryan Oil Co. and Plains Exploration Co. 1 Wood Land Co., NE NE SE 11-7n-48w, TD 4,448 ft., dry, Niobrara 3,020 ft., Ft. Hays 3,425 ft., Cody 3,476 ft., Greenhorn 3,685 ft., Da-

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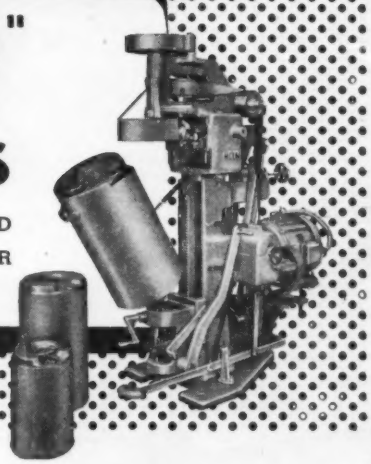

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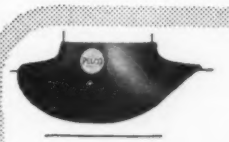

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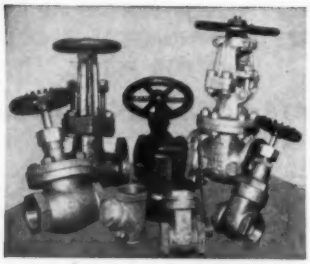

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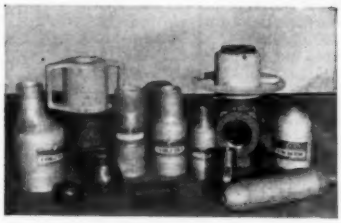

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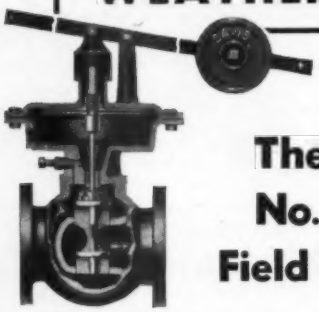

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GIVE YOUR ENGINES THE MAGIC OF MARVEL MYSTERY OIL

In gas fueled engines, especially, it takes a minor miracle to *properly* lubricate top cylinder areas. Here, where heat is highest, lubrication is usually lowest . . . and wear is greatest! That's where Marvel Mystery Oil and the Marvel Inverse Oiler go to work for you.

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The Model TU Marvel Inverse Oiler, easily installed, proportions the flow of Marvel Mystery Oil precisely to the needs of your engine.

kota 3,899 ft., Lakota 4,195 ft., Morrison 4,440 ft.

MONTANA WILDCAT FAILURES

Broadwater County: Dunbar Oil Co. 1 Dunbar, SE SW SE 8-2n-1e, TD 2,124 ft., dry, Livingston 321 ft., Ellis 1,557 ft., Amsden 1,640 ft., Madison 1,945 ft., Sappington sand stone 2,050-2,100 ft., Three Forks shale 2,100-24 ft.

Cascade County: Lee N. Edwards 1 Giffen Coal Mines Co., E½ SE SW 1-18n-4e, TD 560 ft., dry, Ellis-Madison 349 ft.

Yellowstone County: Billings Oil & Development Co. 1 Mosegad, CE½ NE NE 14-2s-23e, TD 2,348 ft., dry, Frontier 900 ft., Dakota 1,931 ft., Lakota 2,065 ft.

UTAH WILDCAT FAILURE

Grand County: Wise Oil Co. 1 State, SE SE SE 19-21s-24e, TD 387 ft., dry, Dakota 325 ft., Lakota 367 ft.

NORTHERN NEW MEXICO SUCCESSFUL WILDCAT

San Juan County: Stanolind Oil & Gas Co. 1 Sullivan, NE SW NE 11-27n-10w, TD 1,971 ft., flowed 689,000 cu. ft. gas daily, Pictured Cliffs 1,877 ft.

IDAHO WILDCAT FAILURE

Cassia County: Couger Oil Co. 1 Govt., NW NE SW 23-13s-26e, TD 2,230 ft., dry.

WESTERN NEBRASKA WILDCAT FAILURE

Kimball County: S. E. and A. C. Torgeson et al., 1 Evertson, NW SE NW 24-14n-56w, TD 6,905 ft., dry, Niobrara 5,480 ft., Ft. Hays 5,698 ft., Codell 5,800 ft., Greenhorn 5,980 ft., "D" sand 6,298 ft., "J" sand 6,424 ft.

Canadian Fields

Red Deer Lake Test Runs High on Reef

CALGARY.—McCarty & Coleman's Red Deer Lake venture, 1 Walter Glen, found D3 Devonian reef some 124 ft. higher than at a disappointing wildcat 5 miles to the south. Logging D3 at 5,315 ft., the well had drill-stem test 21 ft. in the zone after cores showed some gas and oil stains. The test is located in LSD 1, 28-43-22w4, central Alberta, 12 miles southwest of Socony-Duhamel's Camrose discovery.

Baron's oil discovery is now on steady production and at the end of the week had delivered 994 bbl. of oil to tanks. It is planned to operate the well at approximately 100 bbl. per day. This strike, in LSD 10, 15-12-23w4, southern Alberta, is the first commercial production from the Viking sand in this part of the province. The first development of Viking sand oil was in Joseph Lake field, 200 miles north of the Baron test.

CANADIAN WILDCAT FAILURE

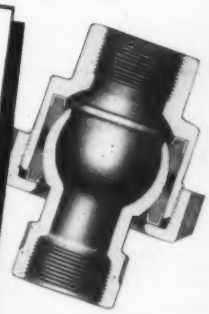
Royalite-Manning 1, LSD 8, 4-92-23w5, dry, TD 6,353 ft.

EASTERN CANADA

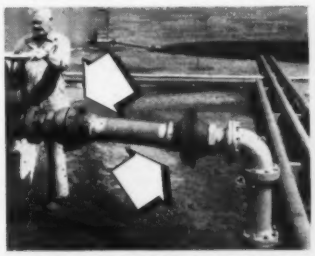
CHATHAM, Ont.—**Manitoba:** Possibilities of Souris Valley Oil Co. Downey 1, drilled 17 miles from Melita in southern Manitoba, have not yet been determined, but arrangements are being made for additional drilling. Testing has been delayed by a repair job, after an oil showing, the first in the province, was met at 3,200 ft.

Quebec: In the Gaspe Peninsula of Quebec, Quebec Oil 1 is below 1,890 ft. after penetrating more than 900 ft. of unusually hard formation, in which the well showed a marked tendency to deviate from the vertical. Acid-bottle deviation tests were made every 5 ft. and the hole repeatedly shot with dynamite to keep it straight. Recent drilling has indicated a softer formation, with the prospective oil zone now estimated around 2,200 ft.

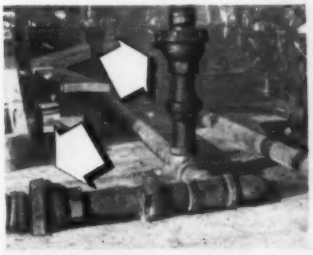
When You Want PIPING FLEXIBILITY



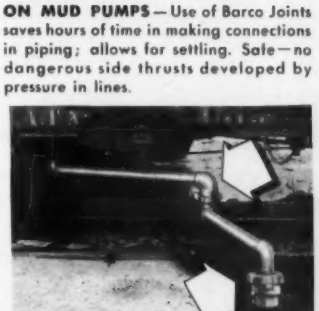
Barco Flexible Ball Joint, Style 7-8 — one of many different styles.



ON TANK CONNECTION LINES—Two 6" Barco Joints make a flexible connection to allow for settling of tank or piping. Widely used in earthquake areas to guard against shock.



ON MUD PUMPS—Use of Barco Joints saves hours of time in making connections in piping; allows for settling. Safe—no dangerous side thrusts developed by pressure in lines.



ON LOADING OR UNLOADING LINES—It's easy to provide for any desired movement with Barco Flexible Ball, Swivel, or Swing Joints! Available in magnesium for light weight!

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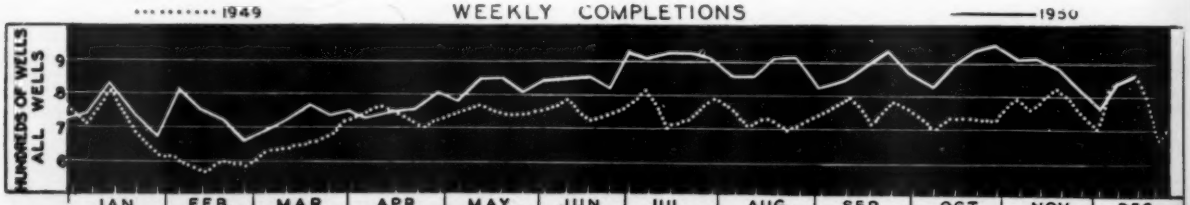
CURRENT STATISTICS

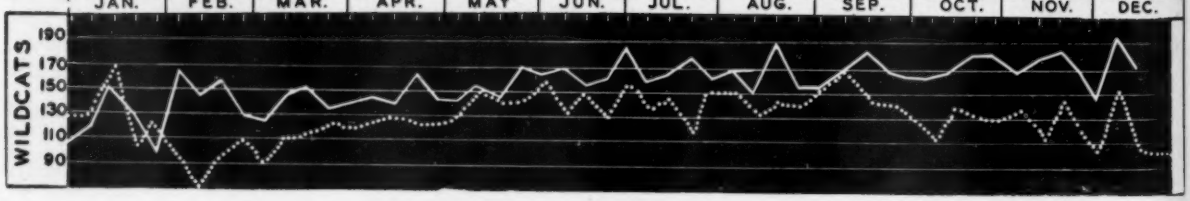
EXPLORATION

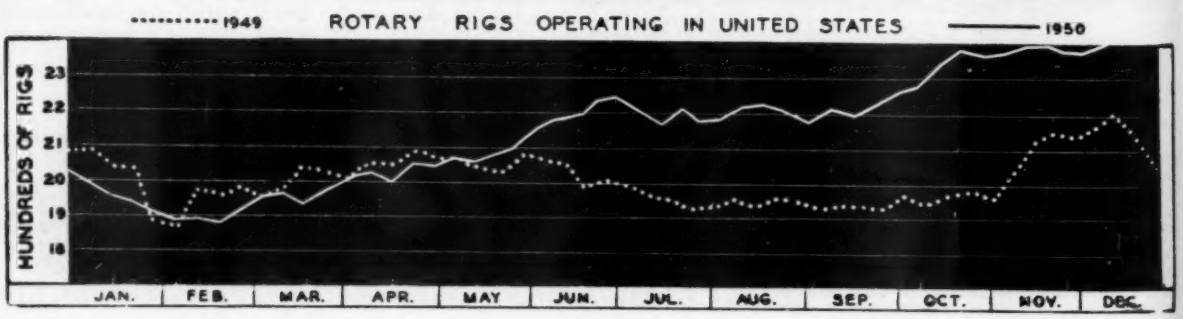
WEEKLY WELL COMPLETIONS . . . . WEEK ENDED DECEMBER 16, 1950

	Total of all wells					Dec. 16		Wildcat completions and discoveries										
													Cumulative total, 1950					
	Comp.	Oil	Gas	Dry	Footage	1950	1949	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	4	2	0	*2	5,824	636	904	0	0	0	0	0	0	0	0	0	0
Pennsylvania	10	4	2	†4	11,568	1,263	1,503	0	0	0	0	0	0	0	1	3	4
West Virginia	5	1	2	2	14,001	626	505	0	0	0	0	0	0	0	24	20	44
Ohio	15	3	4	‡8	33,267	987	1,065	0	0	0	0	0	2	0	2	15	19
Indiana	26	12	0	14	45,931	1,555	1,302	1	0	0	1	2	54	0	2	245	301
Kentucky	22	7	4	11	47,045	1,133	996	2	0	0	6	8	29	0	1	97	127
Illinois	56	22	1	33	127,793	2,765	2,604	0	0	1	9	10	54	0	5	596	655
Michigan	17	9	0	8	40,183	857	969	0	0	0	6	6	33	0	6	294	333
Kansas	100	46	15	‡39	299,698	3,770	3,226	5	0	0	20	25	112	0	13	634	759
Nebraska	5	2	0	3	19,015	139	33	0	0	0	1	1	8	0	4	59	71
Oklahoma	116	66	9	*41	447,520	5,254	4,215	4	0	1	15	20	152	6	20	636	814
Texas	339	221	10	108	1,554,209	15,896	13,024	18	0	0	52	70	499	46	107	2,615	3,267
North Central (Dist. 7-B & 9)	84	37	0	47	243,257	4,804	4,337	6	0	0	20	26	215	2	30	1,016	1,263
West (Dist. 7-C & 8)	119	102	0	17	631,641	4,815	3,186	5	0	0	8	13	98	3	6	525	632
Panhandle (Dist. 10)	23	14	8	1	66,679	864	928	0	0	0	0	0	1	0	2	19	22
Eastern (Dist. 5, 6, & 6-P)	21	13	2	6	103,556	1,101	830	0	0	0	1	1	16	6	3	189	214
Gulf Coast (Dist. 2 & 3)	47	30	0	17	309,078	2,235	1,927	5	0	0	8	13	84	22	41	396	543
Southwest (Dist. 1 & 4)	45	25	0	20	199,998	2,077	1,816	2	0	0	15	17	85	13	25	470	593
Louisiana	42	22	2	18	232,297	2,353	2,295	0	0	0	5	5	48	16	6	217	287
Northern	24	13	1	10	85,235	1,266	1,389	0	0	0	3	3	14	3	2	111	130
Southern	18	9	1	8	147,062	1,087	906	0	0	0	2	2	34	13	4	106	157
Arkansas	10	8	0	2	33,254	390	318	0	0	0	0	0	10	0	0	84	94
Mississippi	5	2	0	3	38,527	297	325	0	0	0	2	2	11	2	0	112	125
Southeastern States	2	0	0	2	6,344	58	46	0	0	0	0	0	1	0	1	30	32
Montana	18	12	1	5	35,751	264	253	0	0	0	3	3	2	0	0	46	48
Wyoming	14	5	0	9	67,432	582	578	0	0	0	4	4	23	0	1	94	118
Colorado-Utah	4	1	0	3	11,914	110	135	0	0	0	2	2	6	0	4	63	73
New Mexico	17	9	6	2	65,561	590	492	1	0	1	1	3	12	1	4	56	73
California	35	27	0	8	149,090	1,760	2,468	3	0	0	7	10	32	0	4	375	411
Miscellaneous (Idaho)	1	0	0	1	2,230	53	26	0	0	0	1	1	0	0	0	28	28
Total United States	863	481	56	326	3,288,454	41,338	37,282	34	0	3	135	172	1,088	71	205	6,319	7,683
Total previous week	842	475	48	319	3,366,899	....	....	20	1	7	165	193	1,054	71	202	6,184	7,511
Total December 16, 1949	871	479	76	316	2,979,692	....	....	22	2	4	125	153	902	82	186	5,391	6,561

Service wells included: *2, †4, ‡1.







DAILY AVERAGE PRODUCTION FOR WEEK

	Dec. 16 crude oil	B. of M. Dec. demand	Dec. 9 crude oil
Alabama	2,500	2,400	2,400
Arkansas	81,550	88,000	81,650
California	964,700	955,000	963,800
Colorado	76,800	67,000	75,800
Eastern	52,000	67,000	52,000
Florida	1,575	1,600	1,550
Illinois	170,600	180,000	168,300
Indiana	30,200	31,000	30,700
Kansas	285,150	306,000	313,100
Kentucky	30,500	31,000	31,400
Louisiana	590,400	610,000	590,500
North Louisiana	114,450	.....	114,550
South Louisiana	475,950	.....	475,950
Michigan	39,700	47,000	43,200
Mississippi	103,200	112,000	104,150
Montana	22,400	24,000	22,500
Nebraska	4,700	6,000	5,500
New Mexico	130,800	142,000	130,800
Oklahoma	493,250	468,000	492,750
Texas	2,375,425	2,380,000	2,375,425
Dist. 1 (Southwest)	31,000	.....	31,000
Dist. 2 (Southwest)	141,350	.....	141,350
Dist. 4 (Southwest)	218,375	.....	218,375
Dist. 3 (Gulf Coast)	425,700	.....	425,700
Dist. 5 (Eastern)	40,075	.....	40,075
Dist. 6 (Eastern)	92,150	.....	92,150
East Texas field	269,700	.....	269,700
Dist. 7-C (West)	71,825	.....	71,825
Dist. 8 (West)	773,400	.....	773,400
Dist. 7-B (W. Central)	72,650	.....	72,650
Dist. 9 (N. Central)	149,200	.....	149,200
Dist. 10 (Panhandle)	90,000	.....	90,000
Utah	3,800	4,000	3,300
Wyoming	183,100	188,000	177,200
Total United States	*5,642,350	5,710,000	5,666,025
Change from prev week, down	23,675		
Canada	86,610	.....	96,305

Total U. S. production January 1-December 16 †1,895,021,905 bbl.
Same period last year (crude plus cond.) ..... 1,776,805,700 bbl.

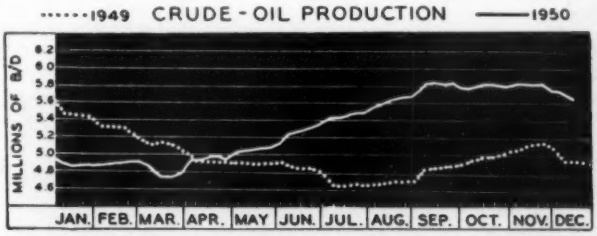
*Not including 101,920 bbl. condensate. †Including 34,242,250 bbl. condensate.

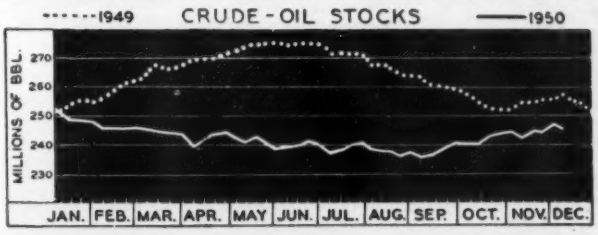
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

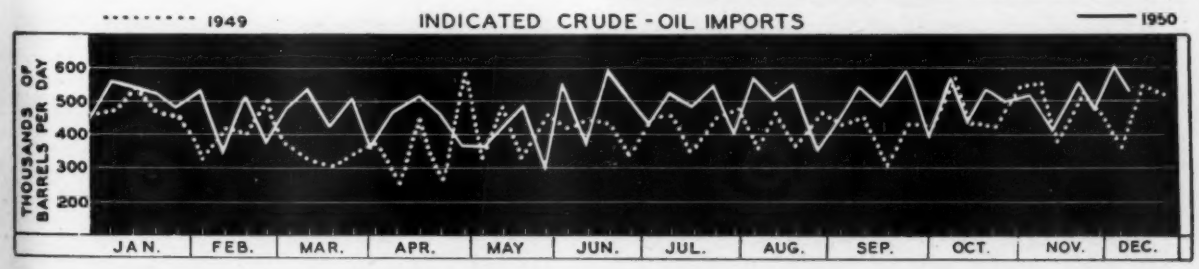
(Thousands of barrels)

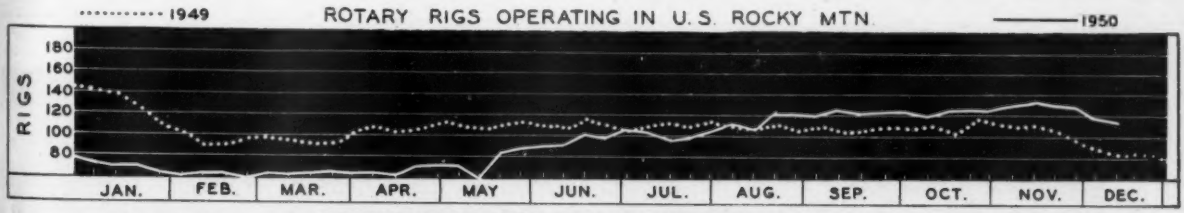
	Dec. 9, 1950	Dec. 2, 1950	Dec. 10, 1949
Pennsylvania Grade	2,129	2,097	2,932
Other Appalachian	1,257	1,233	1,778
Illinois, Indiana, Michigan	10,152	10,419	11,644
Arkansas	2,507	2,383	2,685
Louisiana	14,332	13,888	14,037
North	2,670	2,810	3,433
Gulf	11,572	11,078	10,604
Mississippi	2,344	2,128	2,475
New Mexico	6,742	7,067	7,414
Oklahoma and Kansas	38,135	38,262	37,613
Texas	119,497	121,516	116,295
East Texas	13,885	14,542	16,160
West Texas	46,235	47,342	43,783
Texas Gulf	29,416	29,604	29,621
Other Texas	29,961	30,028	26,731
Rocky Mountain	11,508	11,221	13,715
California	30,330	30,576	37,763
Foreign	7,499	6,957	8,194
Total	246,342	247,747	256,545

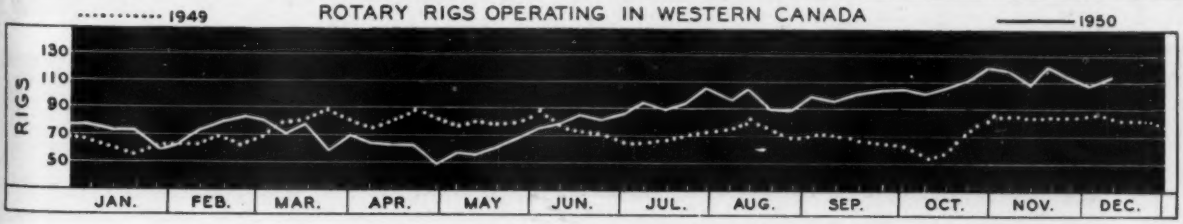
*Bureau of Mines.









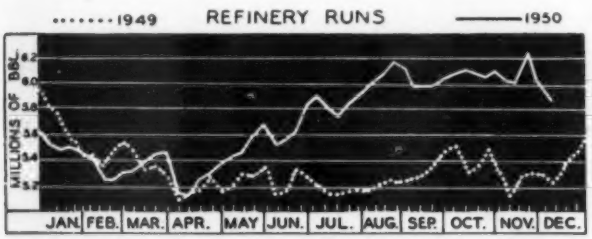


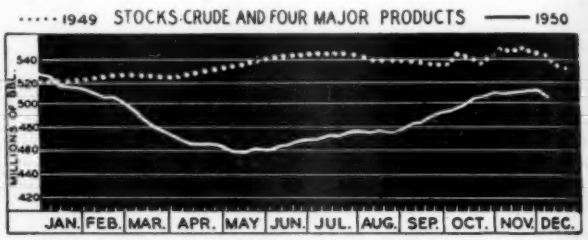
A.P.I. REFINERY REPORT, DECEMBER 9

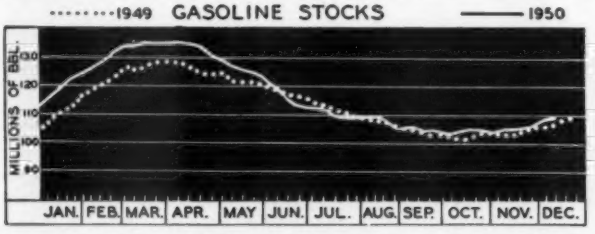
(Thousands of barrels)

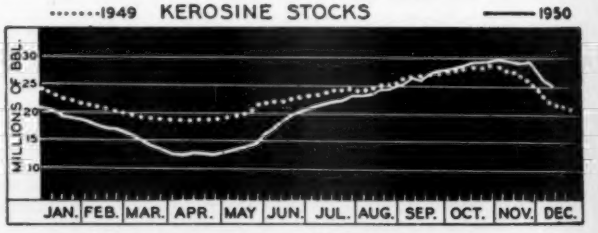
District—	Daily avg. crude runs	Daily average production: Gasoline*	Kerosine	Distillate	Residual	Stocks at refineries, bulk terminals, in transit and in pipe lines: Gasoline†	Kerosine	Distillate	Residual	Bureau of Mines, December 1949: Daily avg. crude runs	Daily average production: Gasoline*	Kerosine	Distillate	Residual
East Coast	899	333.6	33.6	231.1	217.6	24,210	9,583	25,995	10,187	854	345.8	38.5	197.8	214.8
Appalachian:														
District 1	86	38.0	4.9	15.3	9.6	2,844	415	883	442	95	44.2	6.3	14.7	13.4
District 2	59	30.3	4.7	7.0	14.1	1,239	186	234	196	63	32.0	5.3	8.1	14.1
Ind., Ill., Ky.	1,032	544.8	68.0	196.4	166.1	23,099	5,453	12,808	4,521	967	500.1	63.1	170.5	174.7
Okla., Kans., Mo.	490	256.8	17.7	109.0	58.4	11,067	1,310	8,663	1,250	437	242.0	18.1	86.3	59.7
Inland Texas	193	134.3	10.8	27.0	34.1	3,457	451	1,258	613	198	137.7	12.9	23.9	39.5
Texas Gulf Coast	1,392	649.1	111.6	321.3	270.9	16,901	3,884	13,895	6,136	1,324	610.5	114.6	285.8	245.9
La. Gulf Coast	494	231.9	41.7	102.4	62.3	6,988	2,042	3,626	2,267	455	231.4	63.1	88.5	64.4
N. La. and Ark.	67	29.0	6.9	13.0	5.4	1,884	571	949	152	72	31.0	7.0	12.1	15.7
Rocky Mountain:														
New Mexico	15	7.7	.4	2.9	3.9	93	25	39	35	13	7.2	.5	1.8	3.2
Other Rocky Mtn.	200	95.9	8.1	31.0	37.9	2,994	324	1,692	786	174	85.2	5.9	32.5	34.1
California	942	389.7	1.7	128.9	349.8	14,871	803	10,922	16,722	823	365.5	11.6	110.3	323.2
December 9, 1950	5,869	2,741.1	310.1	1,185.3	1,230.1	109,647	25,047	80,964	43,307	5,475	2,632.6	346.9	1,032.3	1,202.7
December 2, 1950	6,034	2,845.3	368.7	1,230.4	1,217.3	109,509	26,491	84,891	45,221	.....	.....	.....	.....	.....
December 10, 1949	5,234	2,602.7	295.4	1,005.3	1,121.9	106,146	23,397	85,926	64,476	.....	.....	.....	.....	.....

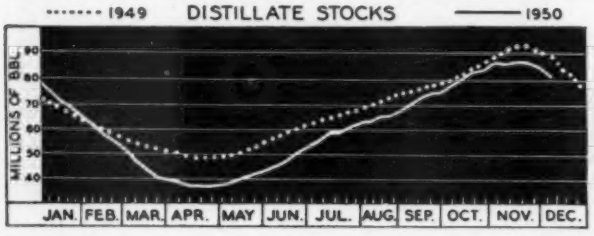
*At refineries including natural blended. †Finished and unfinished.

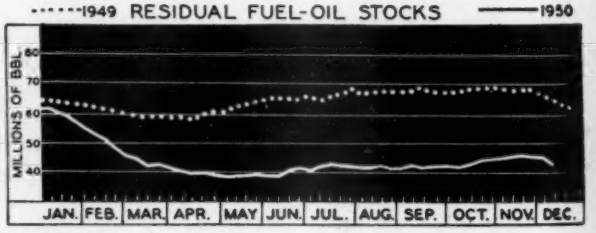


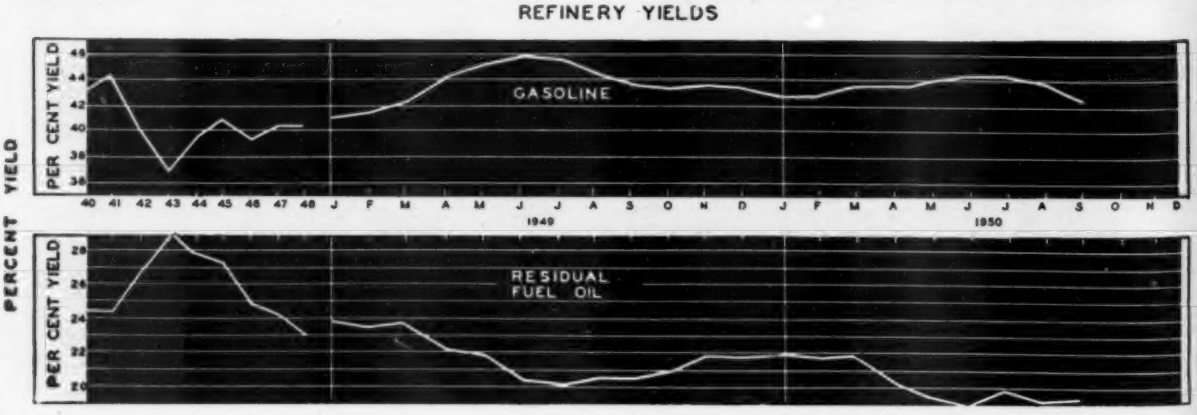












CRUDE PRICES
GRAVITY SCHEDULE

	Signal Hill, Calif.‡	Oklahoma, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$1.93	....	....	....
19-19.9	1.98	....	....	....
20-20.9	2.03	$2.25	....	$2.12
21-21.9	2.07	2.27	....	2.14
22-22.9	2.12	2.29	....	2.16
23-23.9	2.18	2.31	....	2.18
24-24.9	2.24	2.33	$2.56	2.20
25-25.9	2.30	2.35	2.58	2.22
26-26.9	2.36	2.37	2.60	2.24
27-27.9	2.41	2.39	2.62	2.26
28-28.9	2.46	2.41	2.64	2.28
29-29.9	2.52	2.43	2.66	2.30
30-30.9	2.57	2.45	2.68	2.32
31-31.9	2.62	2.47	2.70	2.34
32-32.9	2.68	2.49	2.72	2.36
33-33.9	....	2.51	2.74	2.38
34-34.9	....	2.53	2.76	2.40
35-35.9	....	2.55	2.78	2.42
36-36.9	....	2.57	2.80	2.44
37-37.9	....	2.59	2.82	2.46
38-38.9	....	2.61	2.84	2.48
39-39.9	....	2.63	2.86	2.50
40 and above	....	2.65	2.88	2.52

*For crude from Daboval, El Campo, and Sand Point.

†Includes Lea County, New Mexico. Last general price change represented a 50-cent increase becoming effective December 6, 1947.

‡Standard Oil Co. of California.

FLAT CRUDE PRICES

Representative posted schedules per barrel.	
East Texas†	$2.65
Kettleman Hills, California*	2.80
Beauregard Parish	2.60
Illinois Basin	2.77
Pecos County, Texas (Yates)	2.35
Bradford, Pennsylvania	4.25
Eastern Ill. and Western Ind.†	2.77
Tomball, Texas Gulf Coast	2.83

*37°-37.9°. †35° and above.

CONTINUING high demands for heating fuels are resulting in still firmer distillate and residual markets in all areas. Prices are up on the Group 3 market, and while some major marketers continue the same low postings on the Gulf Coast and in New York Harbor, there were no reports of open-market sales at these postings.

Group 3 prices for No. 2 fuel moved up to 8.375-8.625 cents a gallon, representing an increase of .25 cent a gallon in the past few weeks. In the same period, kerosine moved up .375 cent a gallon to 9.25-9.375 cents. Residual fuel advanced 10 cents a barrel following a 5-cent increase in the previous week. The new low quotation of $1.80 a barrel is 70 cents a barrel less than the low of the market early in 1948.

At least part of the firmness of the Group 3 market is due to transportation shortage rather than an actual material shortage. A sudden jump in heating-oil demand results in a flood of shipping instructions. When suppliers receive enough instructions for immediate shipment to put them several weeks behind on tank-car loadings, part of the buyer's bidding for material actually represents bidding for transportation.

Further advances in coastwise tanker rates have widened the gap between posted lows for light and heavy fuels on the New York Harbor market and replacement costs based on Gulf Coast quotations and new tanker rates. The general firming trend for fuels in all areas and higher replacement costs have almost eliminated open-market sales of distillate and residual fuels in New York.

Standard Oil Co. of California increased the price it pays for heavy crude effective December 12. The new price for 14°-gravity oil is up 25 cents with smaller increases for lighter grades. At the same time, Standard announced a 20-cent increase for heavy fuel.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotation of leading suppliers as of December 18, 1950. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline, 80-82 octane	10⅛-10½	12-12.75	10¾-11
Premium gasoline, 86-88 octane	11⅛-11½	13.5-13.75	11½-12
42-44 w.w. kerosine	9¼-9⅜	10-10.1	8¾-9
No. 2 straw fuel oil	8⅜-8⅝	9-9.25	7¾-8
No. 6 residual	$1.80-1.85	$2.25-2.30	$1.75-1.90

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	6⅞	6⅜	6⅝
Grade 18-55	8.25	7.75	8.0

LUBRICATING OILS

South Texas

200 vis., No. 2-3 neutral	13-13.5
750 vis., No. 3-4 neutral	16
2,000 No. 5-6 neutral	18-19

Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	28-29
200 vis., No. 3 neutral, 0-10 pp.	17.5-18.5

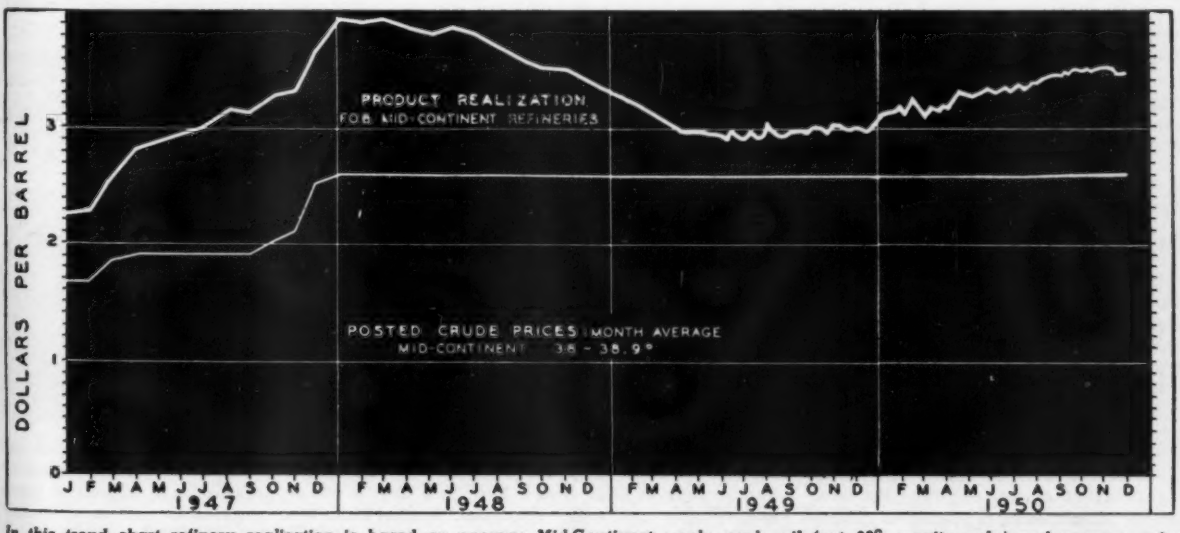
Western Pennsylvania

145-155 vis., 10 p.t. bright stock	31.5
180 vis., 0 p.t. neutral	30.5

WAX

Mid-Continent

132-134 A.M.P.	5.0



In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate, and fuel oil. Realization averaged $3.46 for week ended December 9, $3.45 for previous week, and $3.08 for December 1949.

EQUIPMENT MEN . . . in the News

Chicago & Southern Opens New Tulsa Traffic Office

R. L. WEBB

The Chicago & Southern Air Lines has opened a city traffic office in the Alvin Hotel. Robert L. Webb, formerly of the airline's Houston office, has been named district traffic manager.

According to T. M. Miller, general traffic and sales manager for C. & S., the office was opened to accommodate oil men traveling between Tulsa and Venezuela.

Although Chicago & Southern does not provide air service to Tulsa, Mid-Continent Air Lines' afternoon flight to New Orleans connects there with the C. & S. "Caribbean Comet," which departs daily at 7:30 p.m. for Caracas, Venezuela.

Chicago & Southern introduced its 300-m.p.h. Constellation air liners on its international division for the first time December 15. The planes carry 57 passengers and a crew of 5.

Appert Named Director of Engineering By Lenkurt

Kurt Appert, vice president and chief engineer of Lenkurt Electric Co. since its founding in 1934, has become director of engineering there. The San Carlos, Calif., company manufactures wire-line and radio carrier equipment for telephony, telegraphy, telemetering, and control.

The post of chief engineer is taken by George M. Lebedeff. Before joining Lenkurt, Lebedeff was chief engineer at Heintz & Kaufman and an engineer with Federal Telegraph Co.

Lincoln Announces Changes In Sales Organization

James William Brooks has assumed sales and engineering responsibilities for The Lincoln Electric Co. in the Indianapolis district. He has been transferred from the company's Boston district.

Thomas L. Dempsey has been added to the sales organization as a special field engineer. In addition to duties as sales engineer he has a special assignment of giving engineering service to manufacturers in the Cleveland area who are redesigning machinery for welded-steel fabrication.

John F. Kotchian is now serving industrial accounts as a welding engineer in the company's Chicago district. He has been transferred from the Cleveland district.

Dallett Pneumatic Tools Now Manufactured by Cleco

The Dallett Co. of Philadelphia, which was purchased in 1947 by the Reed Roller Bit Co., has been moved to the Cleco division plant in Houston, where production of Dallett tools and accessories is now in progress.

The combined facilities of Reed Roller Bit Co. in Houston cover 42½ acres of land with over 1,000 modern machine tools and over 542,255 sq. ft. of floor space.

J. D. Hipple Joins Knight Manufacturing Sales Staff

J. D. HIPPLE

J. D. Hipple, intimately acquainted with oil-field equipment and supplies and widely known in the purchasing department of the industry, has joined the sales department of Knight Manufacturing & Supply Co. of Tulsa.

Hipple, who has been with the materials and purchasing department of Skelly Oil Co. for 28 years, is a member of the Tulsa Purchasing Agents Association. He will represent the Knight company in the Tulsa market, according to Dean Knight, president of the firm.

Bossart Appointed to Young Radiator Contract Sales

O. A. BOSSART

The appointment of Otto A. Bossart as sales and engineering representative for the contract products division of the Young Radiator Co. has been announced by John J. Hilt, vice president.

Bossart is a graduate of University of Wisconsin with a bachelor of science degree in mechanical engineering. He has been a member of the Milwaukee chapter of the Society of Automotive Engineers since 1941.

Modern Manufacturing Plant To Be Built at Union, N. J.

Immediate construction of a new manufacturing plant of approximately 272,000 sq. ft., on a 25-acre plot at Union, N. J., has been announced by John A. Hill, president of Air Reduction Co., Inc.

This new facility, providing for the employment of approximately 800 persons, will be used by Airco Equipment Manufacturing Division of Air Reduction Co., Inc., for the manufacture of welding and cutting torches, tips, regulators, oxyacetylene cutting machines, inert gas arc-welding machines, acetylene generators, oxygen and acetylene manufacturing and distribution equipment.

The plant, of brick and steel construction, is all on one floor except for 18,000 sq. ft. of office space.

Oakite Representatives Attend Annual Sales Conference

Field service representatives from the Canadian, New England, New York, St. Louis, and Southern divisions of Oakite Products, Inc., are shown gathered for annual conference held recently at Hotel Statler, New York City, to discuss technical-sales aspects of industrial cleaning and allied operations. Similar end-of-year conferences held in Cleveland and Hollywood were attended by representatives from the company's Chicago, Cleveland, Detroit, Milwaukee, and Philadelphia divisions, and the Pacific Coast, southwestern, and midwestern sales territories respectively.

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UNDISPLAYED CLASSIFIED 12c a word one issue. 10% Discount three or more issues. $3.00 minimum charge. Blind Box in our care counts nine words. Payable in Advance.

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$12.00 a column inch one issue . . .
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EQUIPMENT FOR SALE

USED ROTARY AND CABLE TOOL DRILLING TOOLS, WIRE LINES, E. A. KELLY, BOX 861, OKLAHOMA CITY. PHONE 5-6407.

WELL equipment. New and used spudders, rotaries, core drills, all sizes and types. Cable tools, drill pipe, bits, pipe. Fishing tools rented. Everything for well service. Pressey & Son, Pueblo, Colo.

BOILERS FOR SALE: 18 Code Oil Field Boilers, 50 to 87 H.P., 100 to 200 Lbs. W.P., Operated Under Hartford into 1948, Not Fired Since. Located on Leases Vicinity Pampa, Texas. Offered Subject to Prior Sale. $500.00 to $700 each, as is, where is. Contact Max Harbison, Kewanee Oil Company, Pampa, Texas.

FOR SALE: 8 New 20,000 gal. welded tanks. 12—8,000 gal. tank cars. Darien Corp., 60 E. 42nd St., N.Y., N.Y.

FOR SALE: Large stock of centrifugal, simplex and duplex steam pumps, steam and gas turbines, Clark, Bessemer & Cooper compressor cylinders in 20" stroke. List available upon request. Cities Service Oil Company, Patridge, Bartlesville, Oklahoma.

3—160 CUBIC FOOT Air Compressors. Diesel: Gasoline. J. C. Morrison, Midwestern Drillers, Liberal, Kansas. Phone 2441.

1—4'-0" ID x 40'-6" x 1¼" thick Tower. No trays. Tri-State Supply Company, Box 610, Mt. Pleasant, Texas.

FOR SALE

9—230 H.P. Bessemer Type 10 Engines with compressors, Steel Buildings, Valves, and Fittings complete for installation. Located Salem, Illinois Oilfield.

ENGLE PETROLEUM, INCORPORATED
Box 655, Evansville, Indiana
Telephone 5-5179

FOR SALE

DRILLING STEMS; 2⅜", 3", 3¼", 3½", 4", 4½", 4¾" and 5" in diameter, and from 22 feet to 40 feet long. Used, but in good condition.

HERMAN STRAUSS, INC.
Wheeling, W. Va. Tele. 5170 Wheeling

RECONDITIONED SEAMLESS TUBING

1 ⅞" OD—150,000 feet
1½" OD—100,000 feet
2" OD—100,000 feet
2¼" OD— 55,000 feet
3¼" OD— 65,000 feet

Approximately 9 and 10 gauge wall
Single Random Lengths
Plain Ends—beveled for welding

Write—Wire—Phone

Sonken-Galamba Corp.
2nd and Riverview (X-654)
THatcher 9243 Kansas City 18, Kansas

EQUIPMENT FOR SALE

FOR CABLE TOOLS
DEGEN PIPE AND SUPPLY CO
Box 107, Red Fork Station, Tulsa, Oklahoma

FOR SALE: At Oklahoma City, Oklahoma, large stock used air tools reclaimed from modernizing refinery job as follows: Close quarters drills, grinders, chipping and riveting hammers. Other tools, both new and used, including open end and box construction wrenches, etc. Inventory available Cities Service Oil Company, H. D. Patridge, Bartlesville, Oklahoma.

STAR #83 Spudder, all tools 5" to 10", has drilled only three shallow wells; excellent condition, price $11,000. Contact: John Atha, Grandville, Michigan. Telephone AR 6-2633.

4,000 G.P.M. Fluor Atmospheric Cooling Tower. Good condition, bronze hardware. Being released from service due to expansion program. The Derby Oil Company, Box 1030, Wichita, Kansas.

FOR SALE: Westcott, Foxboro and Emco Gas Meters. Geo. R. Milner. Box 124, Okmulgee, Oklahoma.

FOR SALE: 12,500' used 2⅞" O.D. seamless upset tubing, 10-thread, P.O. Box 1581, Phone 5-3545, Tulsa, Oklahoma.

EQUIPMENT FOR SALE

DRILLING rig located at Greggton, Texas, yard, and consisting of complete steam rotary drilling rig without drill pipe, including 2 120 H.P. oil well boilers, 1 6" Union Tool unitized draw works, 1 12x12 Ajax roller bearing steam engine, 1 14½x7½x18 Ideal mud pump, Ideal rotary table, swivel, crown block, traveling block, etc. Contact Rudco Oil & Gas Company, Box 2018, Tyler, Texas.

COLLARS—COLLARS—COLLARS
Large quantity 7" 10 V thread collars. Call Edco Pipe & Supply Co., 933 or 357, Drumright, Oklahoma.

SUPERIOR COMPRESSORS
2—90 HP Direct Driven, Located Oklahoma City, extra cylinders available. Alfred B. Kern, 223 Wright Bldg., Tulsa, Oklahoma.

Several Army Surplus 4½" x 6" Gaso Duplex 1860 Pumps — two piece skid mounted with Chrysler 8 cylinder engines. Will sell pumps only or complete units about half price.

H. H. COFFIELD
ATTN.: W. H. Orr
Phones: 132—Rockdale, Texas
A-86084—Houston, Texas

4" CAST IRON PIPE MECHANICAL JOINT

6,000 feet immediate shipment. 12 ft. lengths, flanged both ends. 23 lbs. per foot. Excellent No. 1 pipe. Price $1.15 per ft. shipping point.

GASCO
235 Rialto Bldg., Kansas City 6, Mo. BA.1209

LINE PIPE FOR SALE

30,000' 2⅜" OD 3.75# & 4# Good Used Lapweld T&C Range 1 Line Pipe
10,000' 6⅝" OD 18.97# Excellent Grade Used Lapweld, Cleaned, Beveled Ends, 20' RML.
4,500' 6⅝" OD 18.97# Strictly No. 1 Electric Weld, 45' Lengths, Plain Ends.
4,000' 10¾" OD 34# Good Used Lapweld, Plain Ends, Random Mill Lengths.

CASING & TUBING

20,000' 2⅜" OD 4# Good Used Lapweld Range 1 Tubing with New 11½ V-Threads and Collars.
25,000' 5½" OD 10# Reconditioned Seamless Casing, New 11½ V-Threads and New 5⅛" Collars (Recommended for Shallow Wells).
4,500' 7" OD 20# Good Used Lapweld Range 1 T&C Casing, 10 V-Threads.
3,500' 8⅝" OD 25# Good Reconditioned Casing, T&C, 8 V-Thd., Range 1.
3,000' 10¾" OD 35.75# Good Used Lapweld T&C Casing, Range 1, 8 Thread.

OTHER SIZES OF LINE PIPE, SEAMLESS TUBING IN SUITABLE SUBSTITUTE SIZES FOR STANDARD PIPE (EXCELLENT FOR GAS, GATHERING AND FLOW LINES), CASING AND TUBING AVAILABLE FOR IMMEDIATE DELIVERY.

FOR FURTHER INFORMATION, WIRE OR PHONE AT ONCE

A. J. STRUBEL, Broker

SIDney 1791 (Day Phone) HUDson 8152 (Night Phone) . . . 4946 Murdoch, St. Louis, Mo.

EQUIPMENT WANTED

WANTED: 2500′ of good, used 2⅞″ OD Drill Pipe, 30′ lengths with full-hole tool joints. R. F. Hare, 2018 W. T. Waggoner Bldg., Ft. Worth 2, Texas.

WANTED TO BUY: 2000 feet of 4½″ left-hand drill pipe with tool joints. Texas Water Wells, Inc., 951 McCarty St., Houston, Texas.

HELP WANTED

CHEMICAL ENGINEER

FOR PROCESS ENGINEERING—3 to 5 years' experience in petroleum refinery design desirable. Attractive opportunity for advancement. Location Philadelphia, Pa. Send complete resume. Box D-808, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Chemical Engineers for process development and process design on petroleum refining and chemical processes. Prefer individuals with several years' experience in one or both of above fields. Southwest location. Write F. J. Heller, Research and Development Department, Phillips Petroleum Co., Bartlesville, Oklahoma.

OFFICE WOMAN

Have opening for woman experienced in oil stenography and general office work with independent oil company located in Okla. City. Write full information first letter. P. O. Box 1824, Oklahoma City.

POSITIONS OPEN

PROCESS ENGINEERS (Ch.E.'s)
JOB ENGINEERS
INSTRUMENT ENGINEERS

experienced in
Petroleum
Petro-Chemical
and
Chemical Industries
Location New England

Box D-807
The Oil and Gas Journal
Tulsa, Oklahoma

Chemical Process Engineers

Qualified to prepare engineering studies and detailed process designs for petroleum and chemical fluid process plants. Salaried position; location in Boston. In reply please state educational qualifications, work experience, and salary desired. Present employers will not be contacted before personal interview.

STONE & WEBSTER ENGINEERING CORPORATION
49 Federal St., Boston 7, Mass.

HELP WANTED

WANTED: Assistant Plant Superintendent for Natural Gas Plant in vicinity of Alexandria, Louisiana. House and utilities furnished. Box D-802, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST, with the necessary experience to qualify for either District Geologist or special problems geologist in structure and stratigraphy. Headquarters in Shreveport with established producing oil company. Replies confidential. Box D-801, The Oil and Gas Journal, Tulsa, Oklahoma.

SEISMOLOGIST for work in Venezuela. Ten years' experience with four years' interpretive work, family status, salary commensurate with experience and ability. Give full details in reply to The Atlantic Refining Company, P. O. Box 2819, Dallas, Texas.

ENGINEERS

Major oil company operating in the Middle East requires graduate engineers in the following classifications:

SENIOR PROCESS ENGINEER
GEOPHYSICS ENGINEER
GEOLOGIST (SEISMOGRAPH)
ASST. GEOLOGIST (SUBSURFACE)
ASST. CHEMICAL ENGINEERS
ASST. CHEMIST (ANALYTICAL)
GEOLOGICAL DRAFTSMAN

Also we have positions for experienced and inexperienced civil, mechanical, electrical, construction and highway engineers.

If interested, write giving full outline of personal and employment history.

Box D-728
The Oil and Gas Journal
Tulsa, Oklahoma

REFINERY POSITIONS AVAILABLE

Integrated oil company has following positions open in its modernized refinery located in southwest:

NIGHT SUPERVISOR — CRACKING AND POLY PLANT: Responsible for direct supervision of catalytic cracking and poly plant operations, plus general supervision over all refinery workers during night shifts. Must have five to ten years' refinery experience and be thoroughly familiar with all phases of refinery operations.

INDUSTRIAL ENGINEER: Responsible for the investigation of work methods in the processing, maintenance and clerical functions for the purposes of reducing costs, improving quality, or raising yields. Must be graduate Industrial Engineer with three to five years' experience and be familiar with refinery operations.

PERSONNEL ASSISTANT: Responsible for aiding refinery manager on problems relating to industrial relations policies and procedures, interpretation of union contracts, and settlement of grievances. Also responsible for maintaining personnel records, classification and seniority records, and for preparing work schedules. Must have three to five years' personnel and industrial relations work with emphasis on handling grievances and working with union representatives.

In letter, give education, age, military status, experience, and salary expected.

Box D-806, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

NATIONALLY known manufacturer has good proposition for men who have retired from oil production or oil refining. No investment required. Write Box D-788, The Oil and Gas Journal, Tulsa, Oklahoma.

ASSISTANT GEOLOGIST for work in Venezuela on single status, degree in geology plus two years experience with core drill or related work, salary commensurate with experience and ability. Give full details in reply to The Atlantic Refining Company, P. O. Box 2819, Dallas, Texas.

GEOPHYSICISTS WANTED

Positions available immediately for experienced seismologist and gravity interpreter for supervisory work with large, well established Oil and Gas Company. Permanent location, salary open. Geological background and Gulf Coast experience desirable, but not required. Give age, educational background and complete details of experience in first letter. Personal interview to be arranged. Our employees know of this ad. Reply to

Box D-814, The Oil and Gas Journal, Tulsa, Oklahoma

Executive Engineer

Unusual opportunity for aggressive person to act as general manager of newly formed subsidiary of well-known pipe fabricator. Subsidiary will erect power and industrial piping. Candidate should: (1) be graduate engineer; (2) age 35-42; (3) have extensive experience in piping; (4) possess balanced background in sales, engineering and management. Base location N. Y. Metropolitan Area. Salary plus possible incentive arrangement. Write giving complete resume of personal facts, education, experience and compensation desired.

BOX D-812
THE OIL AND GAS JOURNAL
Tulsa, Oklahoma

GOOD OPPORTUNITY

for young

CHEMICAL ENGINEER

with petroleum refining experience

Furnace builders, specializing in petroleum refining heaters for crude distillation, cracking, etc., seek services of young chemical engineer (2 to 3 years experience) familiar with oil refining furnace requirements. Excellent opportunity with small, well established firm located in New York City... All replies confidential, our organization knows of this advertisement.

BOX D-816

The Oil and Gas Journal,
415 Lexington Avenue,
New York, N. Y.

HELP WANTED

Graduate Engineers

GOOD OPPORTUNITIES

for

CHEMICAL ENGINEERS: Five to ten years' experience in Chemical Operations or Development. Work in Application of unit operations, evaluations and economic studies leading to cost reduction. Must be graduate, free to travel.

ENGINEERS FOR UNIT OPERATIONS: Five years' experience in the fields of Agitation, Drying or Grinding, Blending and Screening. Specialized knowledge of Heat Transfer, Fluid Flow and Mass transfer are desirable. Must be graduate. Consultation work.

INSTRUMENTATION ENGINEERS: Five or more years of progressively difficult experience in Instrument Research Development or Design. Must have broad and thorough knowledge of instrument theory and application. Should have some knowledge of Chemical Equipment and its operation. Must be graduate.

POWER ENGINEERS: Must have five to fifteen years' experience in some of the following: operating, testing and maintaining power plant equipment, supervising power plant operations, making cost and evaluation studies, heat balance work, power cost accounting, design and layout of power plants, and the selection and installation of power equipment. Must be graduate.

AIR CONDITIONING ENGINEERS: At least 7 years' experience in selection and operation of heating, air-conditioning, ventilating and refrigeration equipment. Well versed in the theory of thermodynamics, fluid flow and heat transfer. For consulting evaluation, and economic operation services. Must be graduate.

MAINTENANCE ENGINEERS: Five to ten years in planning maintenance work, establishing manpower and material requirements, scheduling and controlling work. Must be thoroughly familiar with Machine and Hand Tools used in Plant Maintenance Work. Must have supervised persons doing maintenance work. Must be graduate. For consultation work.

Give experience, education, age, references, personal history, salary received and salary expected. Please be complete and specific.

ALL INQUIRIES WILL BE CONSIDERED PROMPTLY AND KEPT CONFIDENTIAL

E. I. du Pont de Nemours & Co., (Inc.)

ENGINEERING DEPARTMENT PERSONNEL

Wilmington 98, Delaware

HELP WANTED

FOREIGN and Domestic Oil Employment Directory covering the oil industry, showing where to apply for jobs. Price $5.00. Oil Industry Mailing List, Box 2603, Tulsa, Okla.

EXPERIENCED accountant, capable of supervising production accounting department of substantial Mid-Western independent company. Submit data and photo. Box D-797, The Oil and Gas Journal, Tulsa, Oklahoma.

POSITION Available February 1, 1951, Assistant or Associate Professor with Masters degree or higher in Petroleum Engineering to teach reservoir engineering courses in rapidly growing school with excellent laboratory and other facilities. Qualifications will determine salary, but will be comparable to industry. Location Southwest. Box D-765, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER (JUNIOR) with at least 1 year production or drilling experience to work in Venezuela. Single status preferred. Give full details in reply to The Atlantic Refining Company, P. O. Box 2819, Dallas, Texas.

ENGINEERS, EXECUTIVES, TECHNICAL MEN, SALARIED POSITIONS—$3600 TO $30,000. THIS CONFIDENTIAL SERVICE FOR OUTSTANDING MEN WHO DESIRE A CHANGE OF CONNECTION, WILL DEVELOP AND CONDUCT PRELIMINARY NEGOTIATIONS WITHOUT RISK TO PRESENT POSITION. SEND NAME AND ADDRESS FOR DETAILS. TOMSETT ASSOCIATES, 1204 BERGER BLDG., PITTSBURGH 19, PA.

EXPERIENCED ACID SERVICE MAN. Man wanted to run two unit acid service station on salary and commission. Must be good salesman. Box 11054, Fort Worth, Texas.

REPUTABLE Wichita, Kans, Corporation entering oil business, plans to spend considerable amount money for development and exploration. Want Geologists who can work up drilling deals, get farmouts. Managerial ability, etc. Must be experienced Western Kansas geology. Good salary, interest in deals. Replies confidential. Box D-809, The Oil and Gas Journal, Tulsa, Oklahoma.

ELECTRICAL ENGINEER: New large oil pipeline company requires electrical engineer to handle design, construction and devise maintenance procedures, all classes equipment to 5-KV switch gear. Some familiarity with sub-stations to 110-KV, 5000-KVA desirable but not required. No communications or electronics involved. Include full professional and personal details and minimum salary, first letter. Job is permanent. Box D-761, The Oil and Gas Journal, Tulsa, Oklahoma.

SALES ENGINEERS
OPERATIONS SUPERVISORS
PERFORATOR OPERATORS

Only Experienced Men Need Apply

WRITE ONLY

WELEX JET SERVICES, INC.
3909 Hemphill Street, Fort Worth 9, Tex.

DRAFTSMEN

Wanted—Squad leader and draftsmen with experience in Gasoline Plant and Refinery Piping Experience. Please give experience on application.

P.O. Box 29, Corpus Christi, Texas.

MECHANICAL ENGINEER

New large oil pipeline company requires mechanical engineer to handle design, supervise construction, and devise maintenance procedures on all pump station equipment to 5000 HP, not including electric equipment. Station specifically includes 2000 HP maximum IC engine and centrifugal pump. Complete familiarity with high pressure oil piping required. Men under 35 preferred. Include full professional details and minimum salary first letter. Box D-781, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

ANALYTICAL Chemist with 3-5 years' experience in light hydrocarbon and petroleum chemicals analyses to head plant control laboratory in the Ohio River Valley area. Box D-810, The Oil and Gas Journal, Tulsa, Oklahoma.

MECHANICAL Engineer for employment at Tuscaloosa, Alabama, in asphalt refinery in topping, vacuum distillation and oxidizing. Prefer man with degree in Mechanical Engineering. Three or more years actual experience essential. Salary open. Write Hunt Oil Company, 700 Mercantile Bank Building, Dallas, Texas, giving full particulars of qualifications and experience and names of references.

EXPANDING program of well known geophysical company provides excellent opportunity for a few qualified Party Chiefs. Applicants should have not less than three years experience as Party Chief, be proficient in interpretive skill and have proven ability to administer crew. Liberal compensation based upon competence of applicant. Box D-813, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

SUPERINTENDENT-PROCESS supervisor, engineer, experience in complete refinery operations, desires change. Eighteen years experience in distillation, cracking, reforming, polymerization, treating, blending. Proven administration and technical ability. Box D-794, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTENTION: Well established oil well drilling contractor desires to manage and supervise: Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas, and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No. 131, Ph. No. 131, Hobbs, New Mexico.

DRILLING Contractor operating in West Texas and New Mexico desires to contact small or medium-sized independent oil company who needs an operating manager. Personal interview desired. Twenty years experience in all phases of the oil industry. Address replies to Box D-644, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEER, 1 year experience petroleum engineering Lab. 2 Years drilling operations. Desires Domestic or Overseas position. Box D-803, The Oil and Gas Journal, Tulsa, Okla.

MECHANICAL ENGINEER desires change. 20 years design experience on heavy machinery, including draw works, blocks, pumps. Wants design work on oil country equipment. Box B-798, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPERIENCED in all pump repair and welding, some lathe experience; also gasoline plant operator. Desire change, prefer New Mexico. C. D. Woolf, Box 105-A, Wynnewood, Okla.

LEASE AND DRILLING BLOCKS

HAVE 300 acres Ohio County, Ky., with well drilled to 600 ft. Will give one-half interest to investor for $3500 to complete. James P. Friel, 4 So. 15th St. Phila. 2, Pa.

FOR LEASE: Sections 74, 75, 76, 78, 104 Block B-2, H. & G. N. Ry. Co. Gray County, Texas. Proven production. Southeast of Pampa. For more information write: Box D-815, The Oil and Gas Journal, Tulsa, Oklahoma.

U. S. LANDS in Colorado can be filed for Government oil lease in developing area. Good opportunity. Small Expense. Write S. W. Pressey, Pueblo, Colorado.

TRADE: Casing and tubing for ground floor interest in proven or semi-proven production. Principals only, send full details to Box D-800, The Oil and Gas Journal, Tulsa, Okla.

LEASES ROYALTIES

Producing and Nonproducing
Bought and Sold—Any Area
Inquiries Invited

B. D. BUCKLEY
6635 Delmar Ave., St. Louis 5, Mo.

ROYALTIES

SPOT CASH PAID FOR PRODUCING ROYALTY. SMALL TO LARGEST BLOCKS IN SETTLED OR OLD PRODUCTION ONLY. Oil Specialists since 1934. GERBER & CO., 120 WALL STREET, NEW YORK, N. Y.

SELLING 5% override, 400 acres, North Kaycee Unit, Johnson County, Wyoming. Continental has contract for test. Box D-812, The Oil and Gas Journal, Tulsa, Oklahoma.

WE will buy producing or non-producing oil royalties. Standard Security Company, 115 Broadway, New York 6.

DEEDED ROYALTIES
San Juan Basin & Permian Basin. Write Harry S. Wright, Wright Bldg., Farmington New Mexico.

MONTANA ROYALTIES
Millions of acres now leased by world's major companies, with huge drilling play in prospect. For booklet describing Montana geology and oil development, write Landowners Royalty Company, Box 1225 Great Falls, Montana.

PATENT ATTORNEYS

PATENT Practice before U. S. Patent Office. Validity and Infringement Investigations and Opinions. Booklet and form "Evidence of Conception" forwarded upon request Lancaster, Allwine & Rommell, Registered Patent Attorneys, Suite 418, 815-15th Street, N.W., Washington 5, D. C.

LEGAL BLANKS

BURKHART LEGAL BLANKS since 1908. Oil-Gas (all states), Business, Real Estate, Legal Forms, Leases, Revised With Government Regulations, Commercial Printing. Catalog and Samples on request. Burkhart Printing & Stationery Company, 115 South Cincinnati, Tulsa 3, Oklahoma.

ECA Requests Refund

WASHINGTON.—The Economic Cooperation Administration disclosed last week that it has requested a refund of $43,851.21 from Asiatic Petroleum Corp. allegedly overcharged on three ECA-financed shipments of aviation gasoline and fuel oil to China between June and October, 1948, from East Indies ports.

The demand for refund was based on the ground that the prices charged were not in conformance with Section 202 of the Foreign Aid Appropriation Act of 1949, which specifies that the price charged for a commodity shall not result in a delivered price in the recipient country which is in excess of the delivered price of the same commodity from the United States.

Transylvania Well Reported

Reports coming out of the Russian-controlled areas of eastern Europe indicate that a new oil discovery has been made in the Transylvania border region between Hungary and Romania.

The discovery was described in the vague reports as being northwest of Oradea-Mare which is in Romania near the frontier. However, it was not clear if the well is in Hungary or Romania. The Transylvania region has heretofore produced only gas from several sizable fields.

Refining Program

West Germany plans call for capacity operation

A REFINING program for the 1950-51 fiscal year under which the products requirements of Western Germany will be covered by the processing of 4,226,000 tons of crude in German refineries and hydrogenation works, has been approved by the republic's federal Ministry of Economics.

The program, which was submitted by the Association of Crude Producers and Refiners, calls for capacity operation of German refineries, including both new and rebuilt plants, and the use of the hydrogenation facilities to a greater degree than heretofore. Of the total crude to be processed, 2,976,000 tons will be imported with 1,520,000 tons from sterling sources and 1,456,000 tons from dollar sources.

The 4,226,000 tons projected throughput during the year is equivalent to about 85,000 bbl. daily. The anticipated yield from all refinery operations includes 717,100 tons of gasoline from topping and 536,400 tons from cracking and hydrogenation, or a total of 1,253,500 tons against estimated requirements for the year of 1,350,000 tons.

Other production.—Other production planned against estimated requirements of the country include: kerosine 90,000 tons against 90,000 tons requirements; diesel oil, 1,034,500 tons against 1,300,000 tons; lubricants, 363,000 tons against 320,000 tons; asphalt 382,600 tons against 405,000 tons; and fuel oil, 508,700 tons against 500,000 tons. Of the estimated fuel-oil requirements, 300,000 tons are included for export as bunker oil. The asphalt total includes 20,000 tons for anticipated export sales, and lubricants, 10,000 tons.

Imports.—Of the total crude imports, 2,566,000 tons are scheduled to be obtained from the Middle East. Venezuela will supply 390,000 tons of crude plus 20,000 tons of residues for topping. Among the major allocations of imported crude to individual refiners are: 600,000 tons of Iraq crude to the Anglo-Iranian plant at Hamburg-Finkenwerder; 420,000 tons Iraq crude to the Shell plant at Hamburg-Harburg; 480,000 tons of Arabian crude to the Deutsche Vacuum plant at Bremen-Oslebshausen; and 450,000 tons to the Esso plant at Hamburg-Harburg. A total of 210,000 tons of Kuwait crude is scheduled for the Wesseling hydrogenation works (Shell), and 250,000 tons for the Gelsenberg hydrogenation works (Socony-Vacuum and Jersey Standard).

The breakdown of distribution to refiners includes 30,000 tons for the Ostermoor plant of Mineraloel & Asphalt Werke, A.G., which is scheduled to come on stream early in 1951. The German domestically produced crude, estimated at 1,250,000 tons, will be distributed 826,000 tons of all refineries and 424,000 tons to the Gelsenberg and Wesseling hydrogenation works.

CALENDAR OF EVENTS

The Calendar of Events will be found on page 127 of this issue, immediately following the feature "They Say."

Secondary Recovery

Small field in England increases oil production

A SUCCESSFUL secondary-recovery program carried out in one of the several small fields in England has resulted in a substantial increase in production and expected ultimate output.

The operator is D'Arcy Exploration Co., Ltd., the Anglo-Iranian Oil Co., Ltd., subsidiary, which operates all of the five English oil fields. The three main fields are Duke's Wood, Eakring, and Kelham Hills in Nottinghamshire, which together produce about 1,000 bbl. daily.

Eakring, discovered in 1939, had an original reservoir pressure of about 990 psi. at the datum level of 1,700 ft. below mean sea level. Original saturation pressure of the gas in the field was 390 psi. Because of the absence of a water drive, there was a fairly rapid fall in reservoir pressure with production in most sands, and by 1947, pressure in the Rough Rock formation in Eakring and Duke's Wood and in the Top Grit at Kelham Hills was well below the original saturation pressure.

First water injection was carried out in the Rough Rock zone in the latter part of 1947 through a well drilled into the water zone on the west flank of the Eakring structure. By the middle of the next year, nearly 1,800 bbl. of water daily was being injected into five wells on the rim of the structure. Conversion of a former producer last year made available another well for injection.

Increase maintained.—The resulting increase in production from about 210 bbl. to about 320 bbl. daily has since been maintained. Some marginal wells which started producing since the injection program began are yielding several times as much crude as formerly. It is now anticipated that the ultimate production of this field will considerably exceed the 601,553 long tons cumulative produced from 1938 to 1949.